Railway Mechanical Engineer

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CONTENTS

EDITORIALS

Why This Number?

TWO Shop Equipment Numbers of the *Railway Mechanical Engineer* have preceded this one. The first of these was published June, 1917, and the second June, 1918. This number is much more extensive and elaborate than either of the two preceding ones. There are two very good reasons for this.

As we have pointed out in these columns during recent months, it is necessary to do one of three things if the railroads of this country are to be maintained upon a satisfactory and efficient basis: either rates must be raised, wages reduced, or the efficiency of operation increased. Raising rates is a most difficult proposition and the director general of railroads is, apparently, not disposed to take any steps in this direction. It is desirable that the wages be maintained on the present basis. The only other alternative, therefore, is to increase the efficiency of operation by the introduction of the most efficient and economical methods and practices, by the improvement of facilities, and by bringing up the individual output of each employee. The elimination of piece work in many shops means that they must be entirely reorganized in various respects, in order to maintain their productive capacity even on the old basis. One purpose of this special number, therefore, has been to present constructive suggestions as to increased and more efficient shop production which will be helpful to those who are responsible for the maintenance of locomotive and cars.

The second thought that the editors had in mind in building up this special number has been to bring to the attention of railway mechanical department men all of the recent developments in machine tools and shop equipment that may be helpful to them. This is commented on in detail in the editorial following. Incidentally the editors would like to know to what extent this number proves helpful to you.

New Tool Section

DURING the war the builders of machine tools and shop equipment had little or no opportunity to improve their lines for general purposes, although some really remarkable improvements and developments were made in connection with the work of manufacturing munitions and war supplies. Now that the conditions are becoming more normal, the manufacturers are improving their lines so as to better meet the new conditions in the industrial field. The scarcity of skilled labor and the increased wage scales have created a heavy demand for labor and time saving tools and facilities. Possibly this, more than any other one thing, is the keynote of the large section in this number which is devoted to descriptions of new and improved machine tools and shop equipment.

Possibly something should be said as to the meaning of the expression, "new and improved machine tools and shop equipment." A large part of the material in this section covers entirely new designs. There are, however, a number of articles which cover products that have been improved in some of their parts only; in a few cases, tools or equipment have been described because of the addition of a new size to a line which has already been well established and is well known. Then there are several articles covering tools or equipment which cannot be classed as strictly new or improved because they have been manufactured for some time in practically the same form as they are at present. We decided, however, to describe some of these because recent changes in conditions have made their application to the railroad shops of very considerable importance, and a determined effort promises to be made on the part of their makers to bring them to the attention of the railroads.

Those who are planning on attending the June mechanical conventions will be particularly interested in a number of new or improved tools that are described in this issue which will be on exhibition at Atlantic City.

Our Advertising Pages

IT is rather unusual for the editorial department to make special reference to the advertising pages. We cannot, however, let this opportunity pass without commenting upon the really remarkable display in this special Shop Equipment Number. Great changes have taken place in the advertising pages of the technical and business papers during the past decade. The manufacturers were formerly content with using advertising space largely for display cards in order to keep their names before the public. Gradually they came to a realization that it would be far better to use this space for educational purposes by setting forth in an attractive manner the functions and advantages of their products. The difficulty in many cases was that the manufacturers did not have the facilities for getting together the necessary material or of putting it into attractive shape.

One of the greatest editors which the railway mechanical department has ever produced, used to say that the time would come when the advertising pages would be read in preference to the editorial pages because the advertiser, unhampered by those standards as to form which must necessarily be observed by the editor, would be able to make the material more attractive to the eye. The editors are not worrying, but so rapidly have conditions improved in preparing advertising copy that there is no question but what our readers will be forced to study the advertising pages critically and carefully. Unlike conditions 10 years ago, the copy is changed with each issue, thus helping to maintain the interest.

A large part of the data in the advertising pages in this and in our regular issues includes photographs which were actually taken in railroad shops and upon time studies which were made at the same time. While we have made no actual comparisons, it is quite probable that it costs more to prepare the average page in the advertising section than it does to prepare a similar amount of material for the editorial pages—and the publisher will tell you emphatically that the editorial department of this publication is an expensive institution.

Problems of the Air Brake Organization

THE Air Brake Association met this year under conditions that were more nearly normal than existed at the time of the convention last year. Problems bearing on war conditions occupied the attention of this body at the 1918 meeting; the discussion this year showed that the biggest problem which the air brake department has to face now is the improvement of the standard of maintenance. Last year brake equipment was not adequately maintained, and while some of the deterioration has been offset in the past few months there is still an abnormally large amount of equipment which

is not up to the required standard. With the maintenance forces working shorter hours there is an increased necessity for getting the most effective work from the entire organization. Under the stress of war conditions some of the practices of former years were allowed to lapse. The question to be considered now is, which methods should be resumed and which abandoned.

The experience through which the railroads have passed has demonstrated the need for some organization on each system to supervise the air brake service. Some roads have been inclined to lean rather heavily on the service organization of the air brake companies. The staff of experts employed by the manufacturers should be called on to act only in a consulting capacity and they cannot be expected to handle routine matters such as the training of employees. This is properly a function of the railroad organizations and where the roads do not employ their own forces to handle this work, the service is almost sure to suffer.

The labor situation in the air brake department has undergone a radical change and will probably never revert to the old conditions. In past years there were plenty of competent air brake mechanics, but now the supply is inadequate and the roads must train men to do this work. The intricacies of the modern equipment cannot be mastered in a few days or weeks and in order to build up the shop organization with experienced men, special inducements should be offered to the employees on the more important jobs. In some instances wage differentials recently established have had the opposite effect, and as a result the shop organizations have been disrupted. It seems probable that there will be a large labor turnover for some time to come, as the shifting of workmen will continue until more stable industrial conditions are established. Instructions in the simplest form will be needed to enable the new men in the air brake department to become proficient in their special work as quickly as possible. The general distribution of the M. C. B. instructions on the maintenance of air brakes has had a good effect. The more detailed report of the Air Brake Association's committee on freight car brake maintenance should prove a great help in the difficult work of training the new employees.

Machinery Repairs on Heavy Locomotives

THE changes in the construction of locomotives during recent years have eliminated some of the defects that were most troublesome in earlier designs. Locomotives of moderate size now give large mileage between shoppings, but designs in which the maximum weight on drivers and tractive efforts are sought as a rule have certain weak points which add to the expense of maintenance and the proportion of time out of service. The development of designs for large locomotives in which no part will have an unduly short life demands the attention of those who design and maintain motive power.

It is interesting to note the general changes in locomotive repair work during the past decade. The mileage between flue renewals has probably increased somewhat while there is but little change in other boiler repairs. Frame failures, which formerly were a constant cause of annoyance, have been almost eliminated. General machinery repairs amount to about the same proportion of the total as before, but the work on rods and driving boxes has caused more and more trouble as the size of the locomotives has increased. The increase in rod work is a natural result of the use of larger cylinders, causing greater stresses, without a corresponding incease in the length of bearings. Long rigid wheelbases add further to the difficulty of maintaining rod bushings. The increased wear on driving boxes is due to greater stresses combined with a wider spacing of cylinder centers and a narrower spacing of frames. This is perhaps a more serious matter than the short life of rod bushings due to the greater difficulty of performing the work on the boxes.

The added difficulty of maintaining these important machinery parts will undoubtedly increase the time locomotives are held out of service and may even prove a limiting factor in the design of large motive power units. Comparatively few attempts have been made to improve on the types of bearings used or the material from which they are made and investigations along these lines may lead to the development of more serviceable designs. Another opportunity for eliminating the trouble lies in designing the parts so that they are more easily removed. The most promising alternative, however, seems to be the adoption of an articulated construction for extremely large locomotives. By dividing the power between two units the individual stresses are reduced and in spite of the added complication, the design would probably give less trouble than a locomotive with a long rigid wheelbase and might even in the end prove cheaper to maintain.

Machine Tool Situation Abroad

AMERICAN business men visiting England and the Continent since the signing of the armistice have learned somewhat to their displeasure that while there is a great need for material and manufactured products of all kinds, there is but little actual business being done. This applies particularly to the machine tool industry. The London agents are extremely busy answering inquiries but have received very few orders. The industrials, particularly those which manufactured munitions during the war, are seeking products that can be made without too great a change in the equipment of their plants. With every new product considered there are requirements for machines they do not happen to have and prompt inquiries are made to ascertain the price and deliveries of those machines. Thus the agents are kept busy, all to no seemingly definite purpose. It is this—the readjusting period—that is so trying. And further, but little actual business is expected for possibly two, six or nine months after peace is signed.

The railways, on the other hand, are in immediate need of machine tools, because there was but little replacement of "railway shop machinery" during the war, and because much of this machinery was given hard usage during the war on munition work in addition to railway work. Careful investigators of the market have picked the railroad field as offering the best possibilities for early sales.

The extent to which the American machine tool manufacturer will participate in this field depends on several things. That he will participate to some extent there is but little question in view of the urgent demand, but the extent to which he will participate hinges upon credits, deliveries and price. In the first place it must be remembered that foreign countries needing machines most have been at war, or, if they be neutrals, have felt the effects of war for over four years, and their financial condition is weakened. They need money and credit. Our government can help in this respect. It is rumored that England has made a loan to Roumania for railroad rehabilitation with the proviso that the money be spent in England. With judicious use of the War Finance Corporation's bond issue of $200,000,000, American exporters can likewise be assisted. In the matter of deliveries American manufacturers have the advantage although the shipping problem still remains serious. The price, however, is going to be the principal difficulty. It is not so much the cost of the tool at the point of manufacture as at the point of delivery. With the excessive and unregulated freight rates now existing on vessels sailing out of American ports, the American manufacturer is at a marked disadvantage all over the world. Some commodities can be shipped from England to

South American ports cheaper than from the United States. American shipping must be made to co-operate more closely with the American exporting industry.

At best American manufacturers of machine tools will be at a disadvantage with European manufacturers of like tools in European markets on account of distance. There are many tools, however, which the Europeans have left to American manufacture for the principal reason that, regardless of the additional ocst due to freight charges, they have not thought it profitable to make them. However, if prices remain too high for very long, it is going to pay the European to enlarge his line of tools, and England particularly is anxious to do this. At the present time purchasers, because of the excessive prices, are buying only those American tools they absolutely must have. Where by any chance purchases can be delayed, they are, with the hope that lower prices will come later. Some even suggest that purchasers are waiting for a low German market! It really is a serious question as to how long sentiment will stand up against a depleted pocketbook. It is very necessary for American machine tool manufacturers, and other manufacturers as well, who really want foreign business to do their utmost in getting into the market, in facilitating credits and extensions and in bringing freight rates down so that they may compete on a more even basis.

The Labor Situation

THE abolition of piece work is a matter of controversy on which there are probably almost as many shades of opinion as there are individuals interested in the subject. But whatever opinion may be held, the fact remains that piece work is out of consideration for the present and it is obviously the duty of everyone having to do with railroad shop administration to accept the situation and make the best of it. In an article on another page will be found a discussion of the fundamentals of wage payment which, while abstract in its treatment of the subject, is worthy of the most careful consideration. The principles therein set forth are, we believe, correct and the first step in the solution of any problem is an understanding of its fundamental principles.

The greatest difficulty in the application of these principles to any system of wage payment lies in the human problem of arriving at a common understanding of what constitutes the "reasonable measure of skill and effort" which the management has a right to expect, and the "commensurate rate" which should be paid for its exercise. It is precisely this problem that underlies the greater part of all our difficulties in securing a satisfactory man-hour output and in maintaining industrial peace. Neither the piece work system, the various bonus systems of wage payment, nor profit sharing schemes have been the solution of this problem. None of them has removed the real difficulty; i. e., the lack of a common understanding by the workmen and the management of what service should be rendered on the one hand and what should be expected in return for that service on the other.

Whatever scheme has been adopted, the basis on which it is administered has been fixed, more or less justly, by one or the other of the interested parties, but never to the satisfaction of both. This is true whether it be a bonus schedule fixed by the management in a non-union shop, or an hourly wage scale dictated by the workmen in a closed union shop. In the former case, whatever the general opinion as to the justice of the basis may be, the opportunity to increase earnings by increased effort has tended to satisfy the more skilled workmen only, the primary cause of general discontent not being removed. In the latter case both parties may agree on the "commensurate rate," but the management is seldom satisfied with the "measure of skill and effort". which is exercised in return. The two cases are fundamentally the same; in neither have both parties to the agreement had a voice in framing the platform on which they must work together.

In either case the principle is despotic, whether or not it results in injustice. Self-respecting human beings can not be contented when subjected to despotic control, even though its exercise may not result in tyranny. It is an inherent characteristic of human nature to desire a hand in the settlement of its own destiny.

A number of experiments in what has come to be designated as industrial democracy are now being conducted, notably in the steel industry, the outcome of which it would be unwise to predict. They are all based on the same fundamental principle, namely, that the management on one hand and the workmen on the other have equal rights to a voice in the determination of the conditions under which they must work together. Whatever the results of the detail plans which have been put in practice may be, the principle on which they are founded is sound and the experiments may well be watched with the keenest of interest.

There is nothing radical in this principle. It is the basis of all contracts and is the only way in which whole-hearted support of an agreement can be secured from both parties interested. Terms virtually dictated by either party, no matter how just in themselves, are not conducive to the best relations between the parties during their administration. This principle does not interfere with the right of the management to exercise its functions. It is still the duty of the management to conduct the industry, the difference between the new plan and time-honored methods being only that it is conducted according to law established by agreement to safeguard the interests of both the management and the workmen, rather than in accordance with the unregulated inclination of either one or the other of the two parties, which may or may not be tyrannous in effect, but which is despotic in principle.

How Railroad Administration Circulars Affect Car Repairs

ONE of the clauses in the contract of the railroad companies with the Railroad Administration provides that the equipment shall be returned at the end of federal control in substantially as good condition as when the roads were taken over. At the present time traffic is light and cars are available for repairs, yet apparently little effort is being made to improve the condition of equipment. The percentage of bad order cars is being reduced, to be sure, but a single heavy repair car requires as much work as several light repair cars and the increase in the number of heavy bad orders more than offsets the decrease in the number of lights, the net result being that there is a deterioration rather than an improvement in the average condition of equipment.

At the present time many of the heavy bad order cars are being set on sidings instead of being sent to the repair tracks. An accumulation of heavy bad order cars presents a serious problem for the shop forces and caring for light repairs to the exclusion of the heavies can only be justified as an expedient for making available the greatest possible number of cars when there is a shortage of equipment. No such condition exists at this time, nor can the policy be justified on other grounds. The Railroad Administration probably did not intend to restrict the repairing of heavy bad order cars; the present situation is rather an incidental result of the attempt to standardize repairs to freight equipment.

The most drastic regulations concerning car repairs are found in circular No. 7, which prescribes standards for repairs to refrigerator cars. The standards in themselves are excellent, but they specify types of construction radically different from those used in the majority of railroad owned refrigerator cars. To require cars to be changed to conform with the new standards would necessitate heavy expenditures.

The situation is further complicated by the provisions of circular No. 20, limiting the amount to be spent for repairs or additions and betterments to equipment. If both these circulars were rigidly enforced some roads would be obliged to retire every refrigerator car they own and the minimum thus affected would probably be 10 to 20 per cent.

A similar situation exists with regard to circular No. 8, which will require a large amount of work or the destruction of a great many cars. It has been estimated that circular No. 8 applied in connection with circular No. 20 would force the retirement of as high as 20 per cent of the cars on many roads. The rules governing minor repairs are also unreasonable in some cases. For instance, to apply a standard body bolster would often necessitate a change in the truck bolster, which in turn would call for new truck sides. It would seem advisable to permit existing standards to be maintained on the older cars to avoid the unreasonable heavy expense entailed under such circumstances.

It is not only in conjunction with the standards for repairs that objections are raised to circular No. 20. The provisions of this circular alone will require heavy expense for remodeling or will force the retirement of many cars. It does not fit in well with the reinforcing programs of the majority of the roads. For instance, some lines have equipped cars of 50.000 lb. capacity with steel center sills, thus making them fit for service in heavy trains and providing a type of equipment that fulfills the requirements in many classes of service, yet the limit of repairs on these cars is set at $75. The circular undoubtedly errs in not taking into account the condition of the individual car. The limit to the amount that can be expended for repairs drops sharply when the car reaches the age of 20 years, though there is no corresponding decrease in the actual value of the car. The circular might be justified if freight cars had a definite and uniform life. As a matter of fact, extended investigation has shown that in actual service the physical condition of cars does not deteriorate beyond a certain point. The condition of individual cars varies considerably, so the amount of expense that would be justified in repairing them would be subject to a corresponding variation.

Because of the operation of circulars 7, 8 and 20 the roads are setting aside many cars, or are making temporary repairs. Such practices will cause the equipment to deteriorate rapidly. Freight cars are now being returned to the owning roads, and as the standards of the individual systems can be followed, the necessity for uniform repair standards no longer exists. Under these circumstances circulars 7, 8 and 20 should be revised in order to facilitate the much needed improvement in the condition of freight cars.

The Mechanical Conventions

The mechanical conventions will be held at Atlantic City this year, from June 18 to 25. The meetings last year were little more than a gathering together of representatives of the various committees so that the convention this year is really the first one since June, 1916. The three years since that time have been crowded with unusual experiences for the men in the mechanical department of our railroads; never has the necessity for maintaining the equipment in good condition at all times been so forcefully drawn to the attention of the chief executives and those in charge of the operation of the roads. Too often in the past the mechanical department has been tolerated as a necessary nuisance. This has rather tended to discourage the mechanical department officers and has hampered the development of the department.

The time is now ripe for the mechanical department to assert itself and to insist upon having adequate facilities and authority to keep the locomotives and rolling stock in such condition that they can be operated to the best advantage. The mechanical department must insist that locomotives be not allowed to run when in poor condition and that the cars be kept on the repair tracks if not in condition to be used. Will the mechanical department officers take advantage of the changed conditions or will they let the opportunity go by and allow the effect of the lesson to be lost? It will be interesting to watch the conventions from that viewpoint.

Of course, it is necessary to develop standards and recommended practices and to spend a lot of time in technical investigations and analyses. It is true that the mechanical department officers are confronted with the most intricate engineering problems and must give much attention to them; on the other hand, they must not forget that they are executives and that the large questions as to organization, personnel, production and things of that sort are far more important in the interests of efficient and economical operation than is the technical detail work of the department. It is strange, in studying the proceedings of the Master Car Builders' and Master Mechanics' Associations, to see how little real attention has been given to these larger problems.

Take the labor problem. There has been too much beating around the bush and too little straightforward talking in the open on this question. It is safe to say that there are a great many mechanical department men who, because of this, are at least a generation behind the times in the understanding of the labor situation and the best ways in which to secure real co-operation between the men and the management. What better place could there be to discuss this problem in a big way than at the Atlantic City conventions?

Piece work has been done away with and there is apparently a tendency to discourage discussing it in public. There is, however, no more important question demanding the solution by the mechanical department than as to the best ways in which to reorganize the departments which were working on a piece work basis in order to keep up their production capacity. The problem can be solved and if the men now in charge do not tackle it in earnest, it will be necessary to supplant them with other men of keener vision. There are many men who, because of experience, environment or nature, have failed to realize the significance of the change that has taken place in conditions in recent years. One big thing that can be done at Atlantic City is for the leaders to develop this situation clearly and to encourage their brothers to tackle the job with renewed energy and inspiration.

Frank McManamy, assistant director of the Division of Operation, has made a splendid move in suggesting that the superintendents of motive power instruct their representatives at the convention to make notes of those things that particularly appeal to them and report back in writing as to the practical things that were brought to their attention at the meetings, either at the formal or informal gatherings or in visiting the exhibits. Mr. McManamy's purpose must not be misunderstood. He is exceedingly desirous that the Railroad Administration should receive credit for helping to make the present conventions the best and most productive that have ever been held. The Administration will make a heavy investment in sending the men to the conventions and it is desirous of getting the biggest possible returns for this expenditure. This is good business and is to be commended. The fact that written reports are to be turned in does not mean, however, that Mr. McManamy or his assistants are going to check up the individuals and criticize their observations.

E. H. Walker, the president of the Railway Supply Manufacturers' Association, has been quick to take advantage of a real opportunity for co-operation with the Railroad Administration; arrangements have been made whereby each railroad man in attendance at the conventions will be furnished with a special and very conveniently arranged notebook, which promises to prove most helpful in noting down facts for future reference or for making the above mentioned reports.

The Northwest Corner of the B. & O. Shops at Glenwood, Showing the Heavy Castings Platform at the Right

THE NEW B. & O. SHOPS AT GLENWOOD

Longitudinal Type, 21 Pits; Crane Service in Erecting, Machine; Boiler, Blacksmith and Tank Shops

A NEW locomotive repair shop which, with the new equipment installed, represents an expenditure of more than $1,700,000, has recently been completed by the Westinghouse, Church, Kerr & Co., for the Baltimore & Ohio at Glenwood (Pittsburgh), Pa. The nature of the new shop layout was largely controlled by the rigid limitations of space imposed by the old shop site, most of which is included in the new shop, as no site for a general relocation was available.

The old shop was housed in a group of buildings starting with an old roundhouse which was used as an erecting shop, adjoining one end of which was the machine shop. The blacksmith shop, boiler shop and tank shop occupied three steel frame buildings with corrugated siding adjoining the end of the machine shop in the order named. Between the boiler shop and tank shop was located a transfer table. These latter three buildings were practically all included within the site of the new shop and continued to house their respective shops until the new structure was erected, after which they were torn down and the equipment rearranged in its proper location in the new building. The old machine shop and roundhouse structures remain and will be used to take care of some of the tank work, hose mounting for the car department, etc.

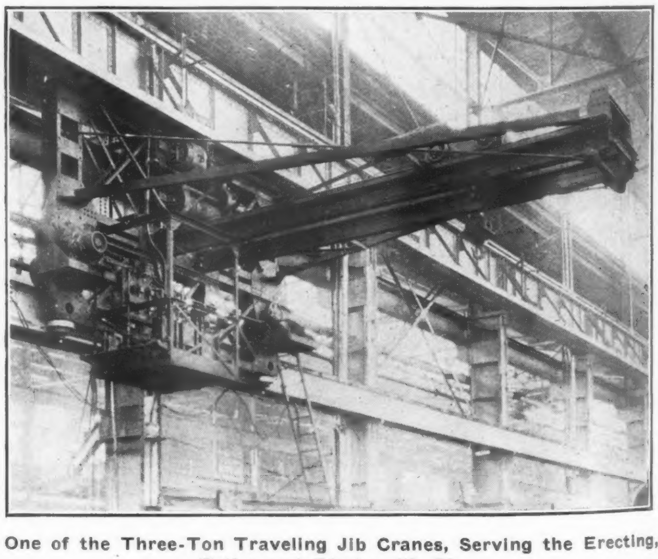
The new shop is of the longitudinal type, of steel frame, brick curtain wall construction and has a total length of 635 ft., with a width of 232 ft. 6 in. It is divided longitudinally into four bays. The monitor bay, 440 ft. of the north end of which is occupied by the erecting shop, is 90 ft. wide. On the east side of this is a single bay 42 ft. wide in which is located the tank shop, pipe shop, tin shop, cab shop and part of the blacksmith shop. West of the monitor bay are two bays, both of which are principally occupied by the machine shop. That adjoining the monitor bay is 62 ft. wide while the outside bay is 40 ft. 6 in. wide. With the exception of 120 ft. at the south end of the building, which is occupied by the storehouse, the outside bay contains a gallery floor, on which space is provided for a manufacturing tool room, facilities for electric repairs, a millwright shop, and the air pump, stoker and injector repair shop, the apprentice school room, offices for the assistant shop superintendent, the general foreman and the supervisor of shop schedules, and toilet facilities.

An unusual feature of the shop structure is the storehouse within the main shop building, which occupies 120 ft. of the west bay at the south end of the building. It is designed for six stories, five of which have been built, and is of reinforced concrete construction.

Along the entire length of the west side of the shop building is a platform 50 ft. wide, served by a 15-ton half gantry crane for about four-fifths of its length. Across the south end of the building is a space of the same width spanned by a 15-ton bridge crane, the surface of which is at ground level.

EQUIPMENT AND FACILITIES

Operating over the entire length of the monitor bay there are one 100-ton Toledo bridge crane, one 100-ton Morgan bridge crane and four three-ton Toledo traveling jib cranes



One of the Three-Ton Traveling Jib Cranes, Serving the Erecting, Boiler and Blacksmith Shop

operating under the bridge cranes, two on either side of the bay. The east bay is equipped with a 30-ton Toledo bridge crane and in the inside west bay there is a 15-ton Toledo bridge crane. In the two west bays there are a number of one and two-ton electrically operated Yale hoists mounted on swinging jibs, about 15 of which eventually will be employed when the shop is fully equipped. There are two

Otis freight elevators used for carrying material between the machine shop floor and the balcony, one of which also serves the storehouse, and an Otis automatic passenger elevator serves the four floors of the storehouse and the main office on the fifth floor.

In addition to the equipment moved from the old shops, the new plant contains 44 new machine tools, practically an entire new spring plant, a new 6,000-lb. steam hammer, two new forging machines, an additional power hammer and several furnaces in the blacksmith shop, and a new flue cleaner. Practically all of the new machine tools have individual motor drive and the greater part of the machines moved from the old shop are arranged for group drive. Many of the larger machines from the old shop were already individually motor driven.

There are two electric welding sets in the shop, one of which is illustrated. Both of the sets are Westinghouse constant voltage type welding machines; one has sufficient capacity for eight operators, while the other has capacity for five. Along each side of the monitor bay there are 12

The Erecting Shop, Looking Toward the South End of the Monitor Bay

welding outlet boxes, making a total of 24 welding outlets. Near the ends of the bay on each side there are transfer panels from which either welding machine may be connected to any welding outlet. Oxy-acetylene tank outfits mounted on trucks are used for cutting.

Good general lighting is provided for the entire shop and individual lights for separate machines have been dispensed with insofar as possible. The monitor bay is provided with four rows of 700-watt incandescent lights placed 22 ft. apart. The lights in the two center rows are fitted with deep bowl reflectors, while those in the outside rows are fitted with angle reflectors. All of the lights are placed above the cranes.

The north end of the east bay is provided with three rows of 400-watt incandescent lamps placed on 36-ft. centers. The two outside rows have angle reflectors and the center row has deep bowl reflectors. In the south end of the east bay the center row of lights is eliminated.

The inside west bay is lighted in the same manner as the north end of the east bay, except that the lights are placed on 22-ft. centers. Under the gallery there are four rows of 200-watt incandescent lamps in deep bowl reflectors 15 ft. apart, with the same lighting in the gallery.

New Tools Installed at Glenwood

2 30-in. vertical turret lathes.	1 26-in. by 12-ft. eng. lathe.
1 84-in. boring mill.	1 30-in. by 12-ft. eng. lathe.
1 44-in. boring mill.	2 27-in. by 14-ft. axle lathes.
1 D. H. rod boring machine.	1 D. H. center drive axle lathe.
1 slab miller.	1 3-ft. radial drill.
1 42-in. vertical miller.	1 4-ft. radial drill.
1 Keyseat miller.	4 5-ft. radial drills.
1 20-in. slotter.	3 20-in. drill presses.
1 24-in. slotter.	1 36-in. drill press.
2 28-in. crank shapers.	1 12-in. by 36-in. plain grinder.
2 24-in. crank planers.	6 emery wheels.
1 16-in. by 8-ft. eng. lathe.	1 100-ton hydraulic press.
2 18-in. by 10-ft. eng. lathes.	1 6,000-lb. steam hammer.
2 18-in. by 10-ft. portable lathes.	1 300-lb. power hammer.
1 20-in. by 10-ft. eng. lathe.	1 1½-in. forging machine.
1 24-in. by 10-ft. eng. lathe.	1 3-in. forging machine.
1 26-in. by 10-ft. eng. lathe.	1 6-in. pipe cut. and th'd machine.

The existing power plant has insufficient capacity for the operation of the new shop and during the day power is brought from the Duquesne Power & Light Company. The night load is handled by the railroad power plant. This plant has been equipped with extra transformer capacity and rotary converters and during the day it is operated as a sub-station to transform the power to the various kinds needed in the shop. The lighting circuits use 110-volt single-phase alternating current, 440-volt three-phase alternating current is required for machine tool and elevator motors and 230-volt direct current power is used for crane motors and some of the machine tool motors.

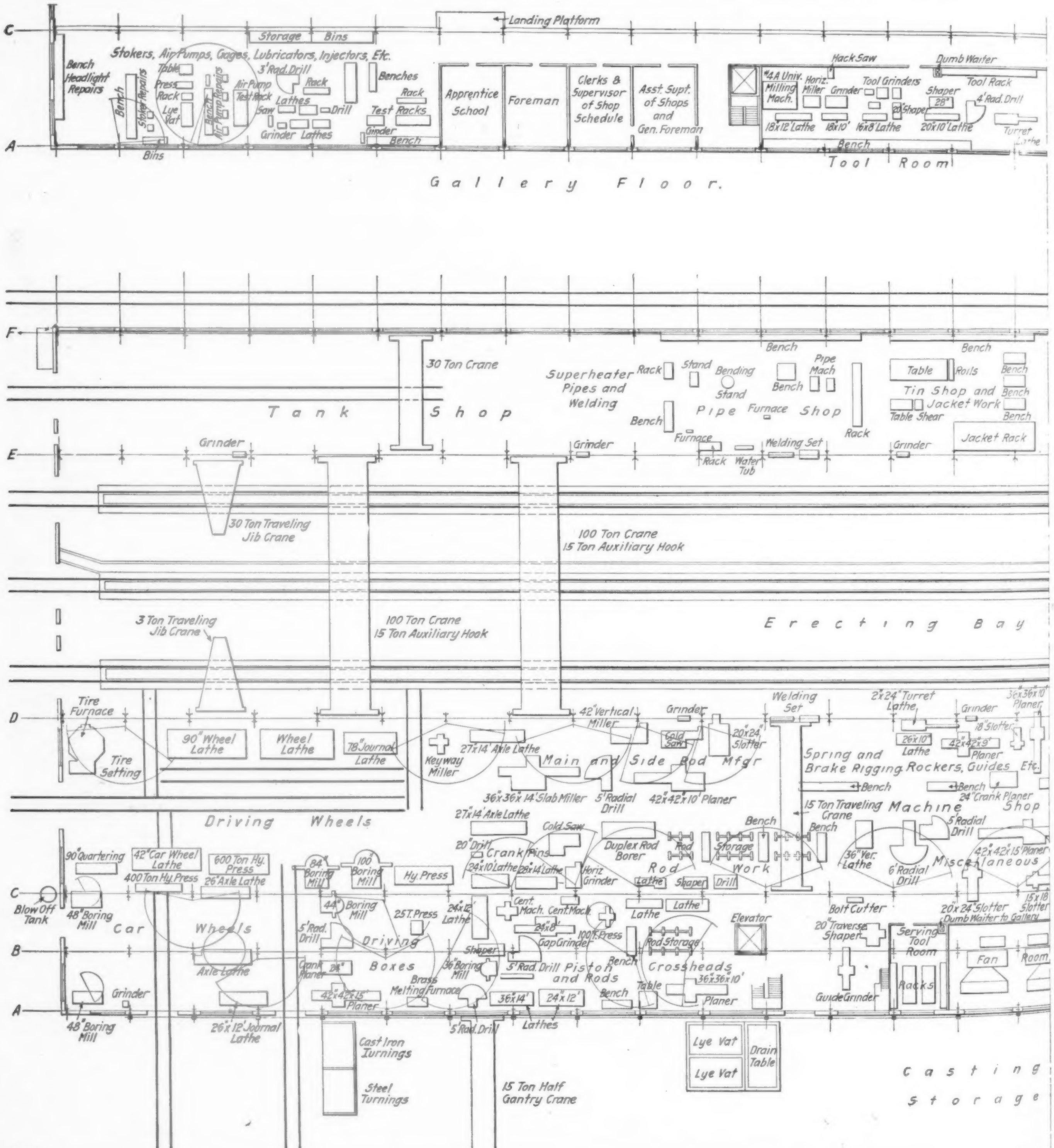
All of the circuits are carried from the power plant to the shop by lead covered cables in fibre ducts under ground. The lighting feeders are brought up through the floor to the various lighting distributing panels, from which the lighting circuits are controlled. Each switch controls either

three 700-watt, four 400-watt or six 200-watt lighting units.

The main power circuits rise from the floor through circuit breakers and cut-outs, just above the floor, to the power feeders, which are run open just under the roof of the east bay and the inside west bay for the entire length of the shop. Branches to individual motors or group motors are carried down the pillars from the feeders. Just before reaching the floor these branches enter a totally enclosed circuit breaker and cut-out, from which they go through a branch cut-out and thence under the floor to the motors. Each branch from the feeders is divided to supply from one to three motors. All wiring in the shop with the exception of the feeders is rubber covered and is all in rigid metal conduit.

Along with the rest of the electrical equipment, the shop is fitted with an electric time clock system. There are 16 branch clocks located at various points in the shop and one master clock located on the south wall of the balcony.

The building is heated by hot air, the system consisting of two 200-in., direct engine driven fans. The plant is a so-



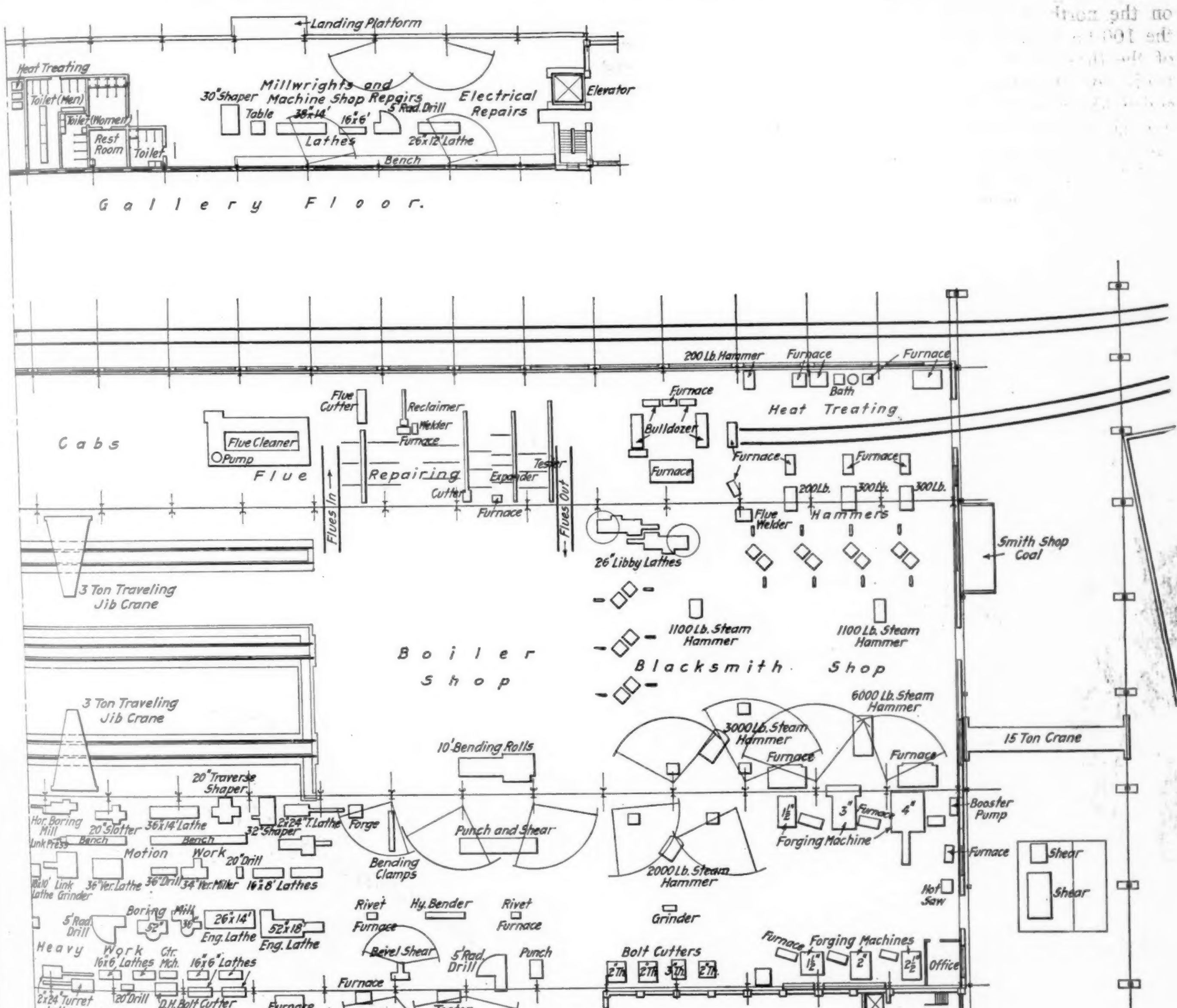
Plan of the North End of the Glenwood Shops

called twin system with one fan for each end of the building. Before passing through the fan the air is heated by 71-in. Ventostacks, placed two tiers high and six stacks wide. The fans discharge into concrete heating ducts, forcing the air to outlet boxes at the columns and along the sides of the building. Each fan supplies heat for half of the building.

ERECTING SHOP

The erecting shop in the monitor bay, is 440 ft. long by 90 ft. wide from center to center of columns. It is provided with three longitudinal tracks, all of which are served by the two 100-ton cranes, while the outside tracks in addition have the service of two three-ton traveling jib cranes each. These cranes have a working range extending across the outside tracks to a line about eight feet inside of the inner rail in each case. The three tracks provide room for 21 working pits.

Space equivalent to about two pits on the east track is reserved for stripping as engines enter the shop. About the same amount of space on the middle track is reserved for



Plan of the South End of the Glenwood Shops

wheeling and coupling up tenders on completed locomotives. At the present time approximately two working pits at the north end of the west track are used for wheel storage, but eventually one of these pits will be released by providing wheel storage outside the shop, only enough space being reserved on this track to take care of one set of wheels at a time.

As far as possible light repairs are taken care of on the east track, while the heavy repairs occupy the middle and west tracks.

As an engine enters the shop it is stripped and unwheeled on the north end of the east track, then being moved by the 100-ton cranes, one at each end, to a vacant pit on one of the three tracks. The locomotives as they are completed ready for wheeling are moved by the cranes to the north end of the middle track to be wheeled and when this operation is completed are replaced on their respective pits, where the erecting is finished, the valves set and the locomotive completed ready to leave the shop. It is then moved back to the north end of the middle track where the tank is coupled on and the engine then removed from the shop.

The three-ton jib cranes are used for handling light material and stripping and erecting the light parts of locomotives on the two outside tracks, thus greatly facilitating operations on these tracks and relieving the large cranes of a considerable amount of light work.

Another feature which facilitates the erecting shop work is the provision of two portable direct motor driven, 18-in. lathes, one in each erecting shop aisle. These are used on frame bolt work and may be moved to any engine in the shop where a heavy run of frame bolts is required.

All scrap material and refuse originating in the erecting shop is collected in open side steel boxes placed on the floor near the north end of the building. During the night scrap and dirt cars are moved into the building on the stripping track and the boxes dumped into them by one of the cranes, the cars being removed before morning.

MACHINE SHOP

The machine shop occupies both west bays, from the north end of the shop 440 ft. to the spring shop in the inside bay, and 260 ft. to the serving tool room in the outside bay. The heavier work is handled in the inside bay, which is served by a 15-ton traveling crane.

The wheel work is grouped in the north end of the building, driving wheels under the crane and car wheels under the gallery. The driving wheel and journal lathes are located so that the greater part of the work moves continuously in one direction. From the storage on the west track in the erecting shop the wheels are either moved by the crane to a cross track just north of the wheel lathe, or moved outside the building and brought in the machine shop on a track which is located in front of the machines and extends inside the shop to the cross track on which the finished wheels are moved over to the erecting shop. The equipment now includes one 90-in. wheel lathe and a 78-in. journal lathe. Eventually, however, another wheel lathe will be installed and a tire furnace will be placed just inside the north wall of the shop. New driving axles are handled just south of the wheel group, the equipment including an axle lathe and a keyway miller. New tires and wheel centers are bored and turned on two boring mills placed on the outside of the heavy machine bay just south of the driving wheel press.

The car wheel group in the northwest corner of the shop has access to the platform on the west side of the building by two tracks which enter the side of the building and extend entirely across the platform. The gantry crane is available for handling the wheels to and from the cars.

Looking North in the Heavy Machine Tool Bay Showing the Day Lighting and the Location of the Electric Lights

Axle and wheel storage occupy the platform adjoining these two tracks.

All driving box work is handled by one group of machines and facilities so arranged that the movement of the boxes from the time the first machine operation is started until they are refitted with the cellars complete, ready for the journals, is continuous with no back handling.

Driving Wheel Section of the Machine Shop Showing the Route of Wheels from and to the Erecting Shop

It is the practice of the Baltimore & Ohio to use brass hub plates and shoe and wedge faces, both of which are cast on the box. As the boxes come from the engines the hub plates are first stripped off on a vertical turret lathe, which also bores main rod brasses and rod bushings. The brasses are pressed out and then holes are drilled in the hub face of the box to hold the new liner on. These holes are drilled at different angles from the vertical in order to clinch the brass and this work is done on a radial drill, the box resting on a special jig which may be tilted from side to side to change the angles of the holes. New brasses are turned on a 36-in. boring mill and the corners fitted on a 28-in. shaper ready to press in the boxes. This shaper is also used to finish new axle keys, crank arm keys and eccentric keys.

The boxes and brasses are then moved to the press, from which they go to the brass furnace, which is placed under a hood opening through the side of the building, where the shoe and wedge faces and hub plate liners are cast on. The shoe and wedge faces are then surfaced on one of the two planers included in the driving box group. A 24-in. crank planer takes care of cellar work and some of the driving box work, while the other planer, which has a 15-ft. table, is also used on new shoes and wedges.

The boxes then go to a radial drill, where the holes for the crown bearing plugs are drilled, and the crown bearings are then bored on a 44-in. boring mill. The boxes are fitted up on the floor just in front of this machine, ready to be moved to the erecting shop.

This group of machines occupies a space less than 50 ft. square and the whole series of operations, including the fitting up on the floor, employs about ten men for from two to three sets of boxes a day.

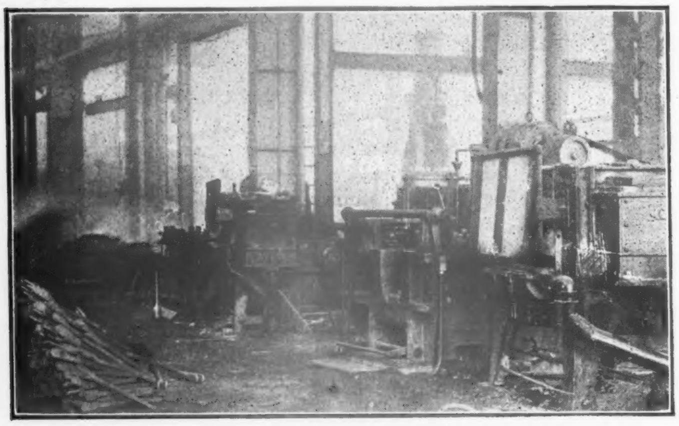
The piston and crosshead work are grouped together in the outside bay just south of the driving box work and the tools and facilities are arranged so that all fitting of the two parts is handled with as little movement as possible.

Crank pins and rods occupy the space in the inside bay adjoining the piston and crosshead groups. New main and side rod work is handled by a group of machines on the side adjoining the erecting shop. These include a slab miller, a vertical miller, a five-foot radial drill, a slotter and a planer. The largest part of the machining on new rods is taken care of on the slab and vertical millers. The slab miller channels and finishes the sides throughout, and finishes the edges of the rod bodies, and the vertical miller is used to finish the edges of the stubs. The slotter is used partly on rod work, for main rod straps, and also finishes

Part of the Wheel Shop Group

the crown brass fit on new driving boxes. Not included in this group of machines, but located just across the longitudinal runway down the center of the bay, is a duplex boring machine. This machine is principally used on side rod work.

The spring and brake rigging work, rockers, guides, etc., and motion work groups adjoin the erecting shop south of the rod group, in the order named. Beyond these groups are the tools for handling miscellaneous heavy work and a number of machines, including two turret lathes, for handling bolt work. A portion of the outside bay opposite these groups is occupied by the serving tool room, which communicates with the manufacturing tool room in the gallery by means of a dumbwaiter. Adjoining the tool room are the fan rooms for the heating system and the toilet and wash room facilities, which include a group of 12 shower baths.



The Heavy Forging Machines in the Blacksmith Shop; Looking Toward the Monitor Bay

THE BOILER SHOP

The boiler shop adjoins the end of the erecting shop in the monitor bay and also occupies the space in the inside west bay adjoining the end of the machine shop. It extends from the south end of the erecting shop to the blacksmith shop, a distance of 88 ft. longitudinally of the building.

With the exception of the bending rolls, the tools are all located west of the monitor bay, leaving a practically clear floor space in the latter.

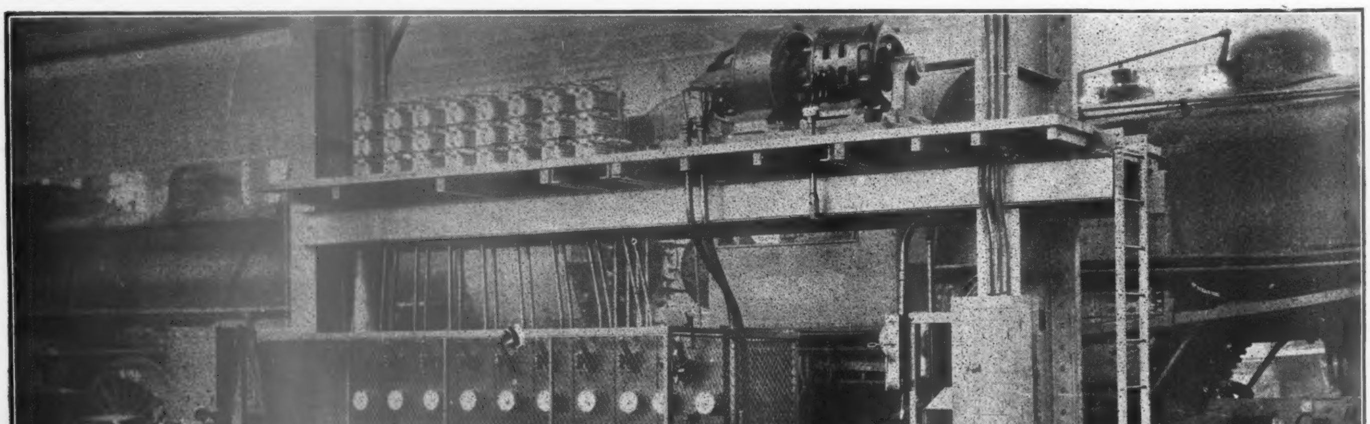
THE BLACKSMITH SHOP

The blacksmith shop is one of the most interesting departments in the plant. In addition to the usual run of light and heavy forgings, bolts, etc., this department includes a highly developed spring shop and also has jurisdiction over flue repairs. This shop handles all locomotive and car forgings for the Glenwood shops, as well as a number of forgings for other points on the system, and repairs four or five sets of flues per month for outside points in addition to those required for the engines in the local shop. It occupies the entire south end of the building with the exception of the corner occupied by the storehouse. Adjoining the boiler shop it is 110 ft. wide and it has additional space in the two side bays, the flue shop occupying 130 ft. of the east bay and the spring shop about 80 ft. under the gallery.

The equipment of the blacksmith shop consists of five steam hammers, three power hammers, four bolt threading machines, six forging machines and two bulldozers, and also includes a 26-in. turret lathe, with provision for the installation of another similar machine. This machine is used on crosshead pins, crank pin collars, knuckle pins, driver brake hanger posts, etc. These parts are rough turned for stock and are used for distribution to outside points, as well as at the Glenwood shops. The bulldozers, which are located on the east side of the shop, form a miscellaneous list of car forgings, which may be loaded directly into cars for removal from the shop on a track extending into the south end of the east bay.

With the exception of the 2,000-lb. steam hammer, which is located in the adjoining west bay, the hammers are all placed in the monitor bay with ample floor space for handling large and heavy material. This part of the shop has the service of the 100-ton cranes and the traveling jib cranes. The lighter hammers are placed adjoining the fires while the 3,000-lb. and 6,000-lb. steam hammers are served by furnaces.

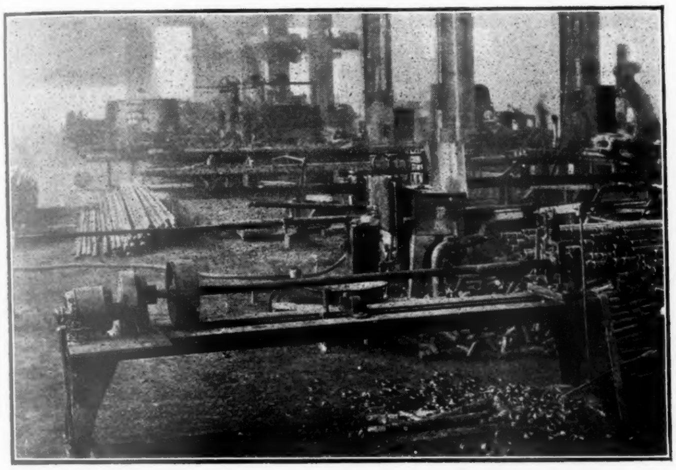
The flue shop is laid out with a view to continuous movement of the tubes from the time they leave the rattler until they are ready for reapplication. They are taken into the flue shop at the end of the erecting shop, where they



One of the Two Electric Welding Sets, Serving Outlets Conveniently Located at Various Points in the Building

are placed in a pit type water cleaner. Adjoining the cleaner in the order named are located the flue cutter, the safe end furnace and welding machine, the cutter for trimming the tube sheet ends and the expander. From the expander the tubes go to the hydraulic tester, thence being removed from the shop. They are handled in and out of the flue shop by means of slings and the erecting shop cranes.

Superheater flues are handled separately. The furnace and welder which are provided for this work are located next to the power hammer group and are so arranged that there is room to handle the tubes between the bulldozer furnace and the turret lathe, longitudinally of the shop.



Looking South in the East Bay at the Flue Shop

The welder is used both for welding safe ends and cutting off the ends of the tubes. It is of the roller type and is converted from a welding machine to a flue cutter by removing the welding rolls and then replacing them with shear disks.

The spring shop equipment is practically all new and when fully installed will provide excellent facilities for this class of work. The equipment includes a hydraulic stripping machine, a hydraulic spring testing machine, a triple pressure assembling and banding machine, a forming table and a nibbing machine. A punch and shear adjoining a rack for storing spring stock, a paint tank for dipping the completed springs and a steam dryer complete the working equipment. The stripping machine, testing machine and banding machine are hydraulically operated and are served by a hydraulic pump and 10-in. by 10-ft. accumulator. The furnaces for the fitting machine and for drawing the temper on the plates each will be equipped with a pyrometer temperature recording set.

As springs are received from the erecting shop, they go to the tester. If the test indicates that the spring is in good condition it is returned to service. Should a broken plate show up, the spring is passed to the stripper where the band is removed and the broken plate and band replaced at the assembling and banding machine.

Where the spring needs renewing, it goes from the stripper to the punch and shear, where stock for new plates is cut. This goes to the nibbing furnace and nibbing machine. From the nibbing machine the plates go to the furnace adjoining the forming table to be heated for forming. Adjoining the forming machine is an oil bath in which the plates are cooled and hardened after being formed. They are then taken to the temper drawing furnace and thence pass to the assembling and banding machine. When completed each spring is tested and then painted.

The completed springs are placed in store stock, the engine from which they are removed is credited with scrap and new springs charged out to replace those removed. When only testing is required the work is charged directly to the engine and the springs replaced in service.

CAB, JACKET AND PIPE WORK

Just north of the flue shop, about 60 ft. of the east bay is provided for making cab repairs. The tin shop, which is largely devoted to jacket work occupies 50 ft. north of the cab work and the next 70 ft. is occupied by the pipe shop facilities. Floor space for taking care of superheater pipes and welding occupies 30 ft. north of the pipe shop.

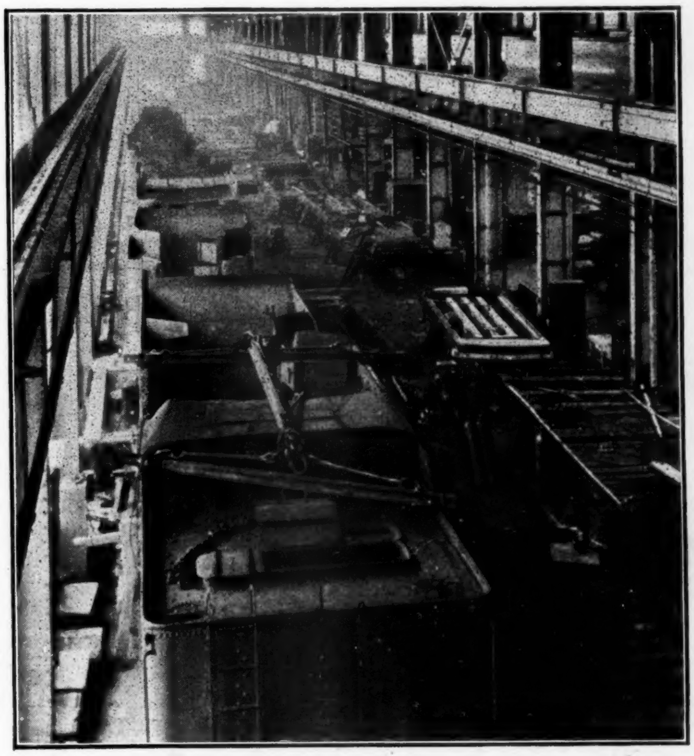
TANK SHOP

The tank shop is located at the north end of the east bay, of which it occupies about 175 ft. This shop is served by one track which enters the north end of the building and extends down the center of the bay about 130 ft. It is served by the 30-ton traveling crane which handles the tanks to and from the frames and removes the trucks from the track, placing them on the floor alongside the track.

The location of this shop at the north end of the building, where locomotives enter and leave the shop, reduces the amount of movement in placing and removing tenders in this shop. It places the shop entirely out of direct communication with the boiler shop. For the handling of such new material as is required, however, the two shops are connected by crane service.

THE GALLERY

On the gallery floor adjoining the storehouse is located the millwright and electrical repair shop, which occupies



A View of the Tender Shop

about 100 ft. Adjoining this shop are toilet facilities for men and women and a woman's rest room, the manufacturing tool room and offices for the assistant superintendent of shops and general foreman, the supervisor of shop schedules and other shop foremen. Room is also provided for the apprentice school. The air pump, lubricator, injector, stoker and gage repairs occupy about 130 ft. at the north end of the balcony.

Two landing platforms project out from the balcony over

the heavy machine shop bay, where they are served by the 15-ton crane. One is opposite the millwright and electrical repair shop and the other near the specialty repair shop. Two elevators are also provided, one at the north end of the storehouse which it also serves, and the other at the north end of the manufacturing tool room.

STOREHOUSE

The storehouse, which occupies the southwest corner of the building is 120 ft. long and about 40 ft. wide. The fifth or top floor is occupied by the offices of the superintendent of shops and the local storekeeper. The four lower floors are devoted to storehouse stock. The fourth floor is given over to bulk storage while the third floor, which opens directly onto the gallery, contains the stock of material for air pumps, injectors, etc., which is disbursed directly on this floor. The second floor contains transportation department material while the ground floor is given over to mechanical department stock.

A storage platform extends along the entire west side of the shop building and is served by a half gantry crane of 15 tons capacity, for all but about 140 ft. of its length. Track clearance at the end of the building made it impossible to extend the crane service to the end of the building. This platform is used largely for storing castings and driving wheel tires, the bridge of the crane being arranged to extend over the adjoining track to permit of handling material to and from cars.

This platform contains two lye vats and a drain table. The parts to be cleaned are handled to and from the shop on trucks, it being the plan eventually to provide electric trucks for this service and for handling material into and about the shop.

Under the craneway at the south end of the building arrangements will be made for the storage of bar iron and steel stock.

NEW SHOP ORGANIZED WITHOUT LOSS OF OUTPUT

During the construction of the new shop the organization at Glenwood has been severely handicapped. Conditions demanded that locomotive repairs continue and an output consistent with the old shop facilities was aimed at during the transition period in which machine tools were being moved from their locations in the old shop to the positions which they now occupy in the new shop. This has substantially been accomplished, the work gradually being concentrated in the new shop as the completion of facilities and the placing of machines would permit.

The construction of the new shop at Glenwood is part of a general plan to relieve the serious shortage of back shop facilities on the Baltimore & Ohio, which also includes a similar but smaller shop at Cumberland, Md. Prior to the construction of these two shops the main shop at Mt. Clare, Baltimore, Md., was practically the only plant capable of taking care of heavy repairs on the road and for some time it has been the practice of the road to contract with the Baldwin Locomotive Works for the handling of some of its heavy repair work.

Each of the new shops has a monthly output capacity in excess of any of the old shops on the system. Prior to the erection of the new shop the output at Glenwood was about 27 engines per month. The new shop, with space for handling 20 or 21 locomotives at one time, is expected to have a monthly output, when all the facilities are completed and the organization fully developed, of about 60 locomotives per month. These will include some heavy running repairs as well as the classified repairs for which the shop is designed. The output of classified repairs will probably run from 45 to 50 locomotives per month and under maximum output conditions the shop will employ a force of approximately 1,200 men.

NEW SECTION OF AMERICAN RAILROAD ASSOCIATION

The Executive Committee of the American Railroad Association has created an additional section, to be known as Section VI, to consider and report upon all questions affecting the purchasing, selling, storing and distribution of materials and supplies, and kindred subjects; and the section will include the former activities of the Railway Storekeepers' Association. In this section the representatives of the railroads will be officers of the purchasing and stores department.

J. E. Fairbanks, general secretary of the association, in circular No. 1949, has issued a tentative code of rules of order for the section, as approved by the executive committee. These rules, in principle and very largely in detail, are like those which have been adopted for the other sections of the association. The membership is divided into three classes, representative, affiliated and life. The present honorary members of the Railway Storekeepers' Association are to be continued as life members of section VI of the American Railroad Association.

The section is to be managed by a general committee of 16 elected members, and, in addition, during the period of federal control, of three representatives of the United States Railroad Administration, to be designated by the director of the Division of Purchases. The elected members must be divided equally between the purchasing departments and the stores departments; and during the period of federal control there must be two from each federal region, and two from Canadian railroads. The regular meeting of the section is to be held in May of each year, and at that meeting officers are to be elected.

The first general committee, which has been appointed by the executive committee, will organize the section and will serve until a regular election is held. This committee consists of the following:

H. S. Burr (Chairman), superintendent of stores, Erie Railroad.
E. J. Roth, manager, Stores Section, Division of Purchases, United States Railroad Administration.
S. Porcher, assistant director, Division of Purchases, U. S. R. A.
G. G. Yeomans, assistant director, Division of Purchases, U. S. R. A.
A. W. Munster, purchasing agent, Boston & Maine.
W. G. Phelps, purchasing agent, Pennsylvania Lines West of Pittsburgh.
E. W. Thornley, supervisor stores, Allegheny Region, U. S. R. A.
E. T. Jellison, purchasing agent, Chesapeake & Ohio.
J. P. Murphy, general storekeeper, New York Central (West).
H. C. Pearce, general purchasing agent, Seaboard Air Line.
H. H. Laughton, staff officer, Materials and Supplies, Southern.
G. E. Scott, purchasing agent, Missouri, Kansas & Texas.
W. A. Hopkins, supervisor of stores, Southwestern Region, U. S. R. A.
F. D. Reed, purchasing agent, Chicago, Rock Island & Pacific.
H. E. Ray, general storekeeper, Atchison, Topeka & Santa Fe.
F. A. Bushnell, purchasing agent, Great Northern.
J. E. Mahaney, supervisor of stores, Northwestern Region, U. S. R. A.
E. N. Bender, general purchasing agent, Canadian Pacific.
E. J. McVeigh, general storekeeper, Grand Trunk.

A meeting of the general committee was held on May 16 for the purpose of electing officers. H. S. Burr, formerly president of the Railway Storekeepers' Association, was elected chairman of the Section. E. J. Roth, formerly vice-president of the Storekeepers' Association, was elected vice-chairman of the Section, and J. P. Murphy, former secretary of the old association, was elected secretary for Section VI. Sixteen committees were organized to carry out the work of this section.

CARS BUILT IN RAILROAD SHOPS.—During the month of March, 1919, there were constructed in railroad shops one steel underframe baggage car, 59 steel freight cars, 44 steel underframe freight cars, 131 cars with steel center sills and 249 wood freight cars, making a total of 484 cars for the month.

FUNDAMENTALS OF WAGE PAYMENT

Variations in Results More Due to Variations in Management Than to Methods of Compensation

THE general abolition of piece work in railroad shops has confronted the managements of these shops with the problem of securing satisfactory output under a new set of conditions. In approaching this problem a clear understanding of the fundamental relations of supervision, labor incentive and labor output are highly desirable if what constitutes a satisfactory output is to be correctly determined and the conditions affecting its attainment properly controlled.

In an article by B. B. Milner, published in the Railway Age Gazette for April 25, 1913, page 952, these relationships

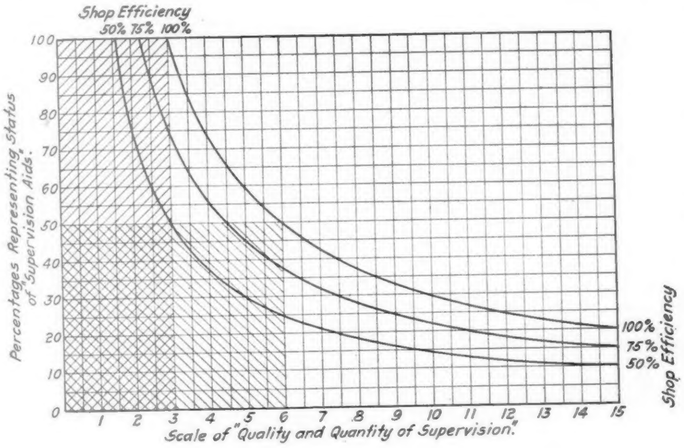


Fig. 1

were set forth in a discussion of the fundamentals of wage payment, the purpose of which was to indicate that all systems of labor compensation, including piece work and the various bonus systems, as well as the straight time basis, if properly administered, are more equally effective than generally supposed. What follows is based largely on the principles then set forth, to which the present situation has given added interest.

The real purpose of the piece-work system or of any of the other so-called reward systems of labor payment is to provide an incentive for the continued exercise of at least a satisfactory amount of skill and energy on the part of the workman. The prohibition now placed on all such systems of wage payment in railroad shops leaves to the workman only a portion of this incentive. It is evident, therefore, if satisfactory results are to be effected where piece work has been abolished, that their attainment becomes more largely a matter of administration, which involves the quality and quantity of supervision and assisting adjuncts provided by the management. Basicly, the problem does not involve the question of shop practice, or shop facilities, but is confined to the relative administration of the various systems of payment under the same physical conditions.

INCENTIVE VS. QUALITY AND QUANTITY OF SUPERVISION

To some it is difficult to appreciate how satisfactory output may be assured. To the incentive referred to—i. e., the ability to voluntarily increase the earning rate by increasing output—most workmen respond at least to the point of maintaining with a minimum amount of supervision their output, even under adverse conditions of shop service and facilities, if not always to the extent of actually increasing their output beyond that represented in a performance which workmen are morally bound to give and the employer has a right to expect under a day-work system. The loss of this incentive may be made up in quality and quantity of supervision and in the conditions and facilities which may be embraced under the general caption of supervision aids—those things outside of the supervising personnel making for the goal of highest efficiency represented by maximum output and minimum cost.

The efficiency obtainable varies with the adequacy of either or both the quality and quantity of supervision and the supervision aids, so that in order to maintain a selected or given efficiency, any loss in one of these items must be made up by an adequate increase in the other.

The principle of this relationship is clearly suggested by the chart in Fig. 1. In this chart note that the adequacy of supervision is relatively represented in the left-hand percentage scale from zero to 100, while the quality and quantity of supervision is represented relatively in the horizontal scale from zero to 15. Uniform efficiencies are represented by the efficiency curves marked respectively 100 per cent, 75 per cent and 50 per cent. These may be algebraically presented by the equation.

Shop efficiency = supervision aids × quality and quantity of supervision,

so that it will be seen that any loss in one of the latter terms must be accompanied by either (1) an increase in the other or (2) a loss in efficiency. For example, if with supervision aids at 100 per cent—that is, of such a character that no fault can be found with them—the resultant efficiency is 100 per cent, quality and quantity of supervision must be of a value arbitrarily denoted as 3 on the chart. If for any reason the value of supervision aids is disturbed by a reduction from 100 per cent to 50 per cent, the quality and

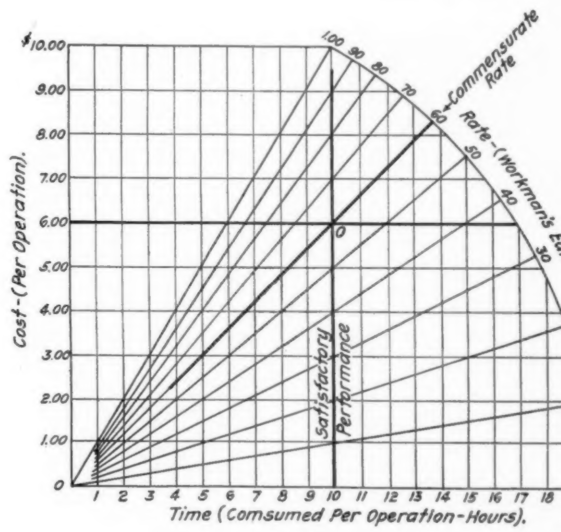


Fig. 2

quantity of supervision remaining constant at 3, the efficiency will also be reduced to 50 per cent, from which point, assuming the continuity of the lowered supervision aids, the efficiency can only be made to again approach 100 per cent by increasing the quality and quantity of supervision toward the value indicated on the chart as 6.

Careful consideration, therefore, of the two complementary factors entering into efficiency is important.

Quantity of supervision is a function of the number of

workmen and the character of work to be supervised—i. e., whether unskilled or skilled, repetition or non-repetition work, operations standardized or unstandardized. The required quantity of supervision also depends on the quality of supervision available.

Quality of supervision involves the personal characteristics of foremen, their attitude toward men, their ability to plan and lay out their work, their genius as leaders of men, etc.

Supervision aids involve the general plan of shop operation, the variety of duties required of foremen, their clerical assistance, shop routing plans and their administration, records reflecting the individual performance of workmen; these should be susceptible of combinations reflecting the efficiency of groups of workmen, sub-departments and of an entire shop.

ELEMENTS OF ALL WAGE SYSTEMS

The concern occasioned by the alteration in the plan of labor payment seems to be based upon an erroneous idea of the differences in the relative efficiencies of the various labor payment schemes. All schemes or systems, properly administered, should bring approximately the same results. The fundamental and inter-dependent elements involved in any wage system are:

(1) The labor cost of production per operation (identical with the workman's earnings per operation).

(2) The rate of the workman's earnings per hour.

(3) The time consumed per operation.

These will hereafter be referred to as the cost, rate and time, respectively.

The time consumed per operation should be understood as that, not of the unusually skilful and rapid workman, nor the one lowest in the scale of skill and speed who is qualified satisfactorily to perform the work, but of the average work-

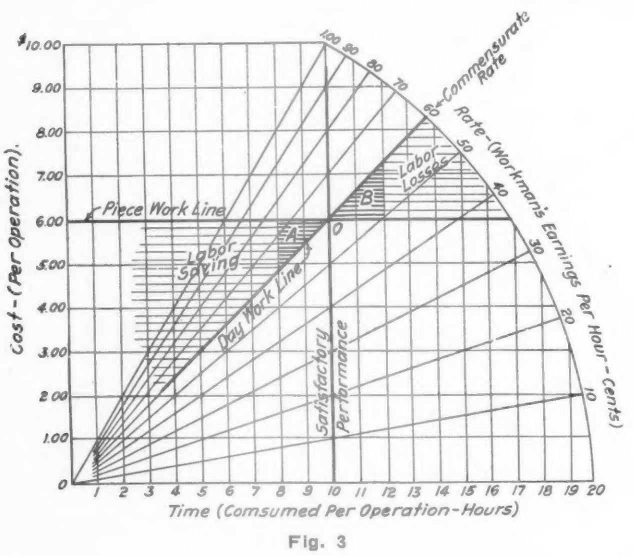


Fig. 3

man who occupies a position between these two extremes. The relations existing between the cost, rate and time elements are expressed by the following equation:

$$\text{Cost} = \text{Time} \times \text{Rate}$$

so simple in application that, having any two of these factors given, few workmen are unable to calculate the desired third. These same relations are presented advantageously by Fig. 2, which geometrically interprets the following equation:

$$\frac{\text{Cost}}{\text{Time}} = \text{Rate}$$

obtained from the previous equation by transposition. Within the range of values exhibited by the cost, time and rate scales, having given any two of these elements, the third may immediately be ascertained by inspection of the chart.

In order to be more specific, in the following development of the relatively small difference which exists in the efficacy of various wage payment systems when properly administered and the advantages which, though smaller than sometimes believed, obtains with the piece-work plan, an operation will be assumed, the satisfactory performance of which requires for ten hours of time the exercise of an amount of skill and effort for which the commensurate rate is 60 cents an hour, as shown by Fig. 2.

It should be understood that what constitutes "satisfactory performance" is prescribed by the management and varies with different managements. Once established for any operation it requires the exercise of a definite amount of "skill and effort" for a definite length of "time." The "skill and effort" required by the established standard of performance commands a commensurate "rate." The product of this "rate" and the "time" determines the equitable "earnings" of the workman and the equitable "cost" to the employer.

Fig. 3 is a duplication of Fig. 2, on which the characteristics of the piece work and the day work systems are represented. From this chart it will be seen that under the day-work system the employee does not participate in the value of labor savings accruing from increased output, as evidenced by the uniformity of his rate of earnings. On the other hand, he does not participate in any of the labor losses resulting from lower output, whereas, under piece work the employee enjoys the whole of the value of labor savings accruing from increased output, and sustains all of the losses which result from a decrease in output. Under the day-work system all labor savings or labor losses, as the case may be, resulting from increased or decreased output, revert to or are sustained by the employer, whereas under the piece-work plan these savings or losses are enjoyed or sustained by the employee, as the case may be. Furthermore, for the time corresponding to satisfactory performance under either system of wage payment, the cost and rate are identical. This situation cannot be disturbed without throwing out of balance the relations which must exist between the "time corresponding to satisfactory performance" and the workman's earnings expressed either as (1) a certain rate per hour, or (2) a certain fixed sum for the completed operation.

EFFECT OF VARIATIONS IN WAGE SYSTEMS SMALL

Between the two extremes represented by the day and piece-work plans there are many systems,—premium, bonus, profit-sharing, etc.,—which may be generally classed as divisional, because they are compromises under which the labor savings and losses resulting from increased or decreased output are divided between the employer and employee. The equity of compensation to the employee and of cost to the employer, in the case of all of them, is dependent on proper determination of the "time corresponding to satisfactory performance," since it will readily be realized that when such time is properly determined, along with the employee's hourly rate, the workman is not concerned in the plan under which he may be paid his compensation, so long as it is equitable and in correspondence with the skill and effort which he exercises. The employee complains justly when, under any system of payment, after having adequately fulfilled his obligation to exercise during a specified time the proper amounts of skill and effort, he fails to obtain his "commensurate rate."

All except unusual workmen, when honestly exercising that amount of skill and effort which they are bound or have agreed to deliver, will not vary much in their output from that represented by satisfactory performance and the time corresponding thereto. In other words, the honest performance of all except unusual workmen will fall within the range of the small triangles of Fig. 3, identified as *A* and *B*, for workmen exceeding and failing respectively to keep pace exactly with satisfactory performance. Since the workman must be paid the commensurate rate for satisfactory perform-

ance, regardless of the system of wage payment under which he may happen to work, the wage lines of all systems must pass through the point O and lie wholly within the triangles referred to.

It becomes apparent, therefore, that under uniform degrees of management efficiency the actual differences due to variation in wage systems are relatively small, and that any large variation in the efficiencies of operation under them must be due to variations in the efficiency of the methods and the management under which they are administered.

So far as the workman is concerned, the most vital factor in administration is the equitable determination of the time corresponding to satisfactory performance. Whether this time be used in the determination of a piece-work price, a bonus or premium system schedule, or the judgment of the supervising officer upon the matter of whether the workman has succeeded or failed to deliver satisfactory performance under day work, the determination of this time is all important. If it is low under the piece-work system, the resulting piece work price will inadequately compensate the workman. So also in the case of the bonus or premium plan, while under the day-work system, the workman may be unfairly criticized by the supervisor. If too liberal, an unfairly large piece-work price will result, which, according to experience under the piece-work system, is subsequently adjusted, i. e., lowered. These adjustments have caused discontent. The same is also true with regard to the bonus or premium schedules, while under the day-work system of operation, it results in a loosely operated, low efficiency shop.

The time consumed in the satisfactory performance of any operation under given conditions can only be determined from some sort of a time study. This is a very elastic term covering a wide range of precision and exactitude from that involved in, say, the gathering of information upon which to base a rough estimate of the time required for a day workman to mow a lawn, to that referred to by some as of the "blood-drawing type," involving the most minute stop watch data which has, in some places, been applied to the determination of working schedules. Workmen rightfully object to the latter, especially until all conditions and adjuncts of shop operation have been reduced to a degree of precision somewhat nearly consistent with the character of the time studies made.

PROBLEM WHOLLY ONE OF ADMINISTRATION

The fact that a reward system of payment is not used does not obviate the necessity of giving the time element any attention. Although not used directly in the determination of wages, the keeping of accurate output records must be of very significant value in connection with the day-work system; in fact, such records are essential to the maintenance of high shop labor efficiency. Such records form an essential part of the "supervision aids" previously referred to, which result in either (1) increasing the capacity of a given "quality and quantity of supervision," with respect to the number of workmen covered, or of (2) making it possible for the same "quality and quantity of supervision" to enhance the shop's efficiency.

The problem, therefore, is wholly one of administration, involving the provision of adequate supervision and of aids thereto, including shop records which may serve as a basis for measuring labor performance under the conditions and practices obtaining, for application to the individual workman, groups of workmen, whole departments, entire shops or to a number of shops collectively considered. To say that satisfactory outputs cannot be maintained under the day-work plan of labor payment apparently is to disregard the fundamental elements of the problem and their mutual relations.

It is, however, unreasonable with the day-work system, at a rate of, say, 68 cents per hour, to expect the exercise and delivery of the same amount of skill and effort within that hour, as under the piece work or any other reward system of payment, in which the workman actually earns a higher rate of compensation, say the equivalent of 90 cents or 95 cents for that hour.

IMPORTANT REVISION OF M. C. B. RULES

Circular No. 37 has been issued by the Mechanical Section of the American Railroad Association for the purpose of reestablishing delivering line responsibility and the practice of defect carding of car in interchange. The text of the circular is as follows: "This circular re-establishes delivering line responsibility and the practice of defect carding as between roads under U. S. Federal Control, and all circulars and interpretations to the contrary are hereby abrogated.

"In view of United States Railroad Administration Accounting Division Circular No. 86, issued April 15, 1919, effective the date of that circular, Articles 1, 2, 3 and 4 of the 1918 Code of M. C. B. rules for freight cars and modifications A to C, inclusive, of the 1918 Code of Rules for Passenger Cars are hereby abrogated and the following will apply to railroads under U. S. Federal Control:

"To the end that interchange inspection work may not be duplicated under U. S. Federal operation of railroads, so that more repair work and less unnecessary inspection will result, it is ordered—

"(1.) That joint arrangements shall be made to prevent such duplication in inspection by arranging all inspection forces at interchange points with a lead or chief joint inspector as conditions require, to supervise the forces and see that inspection and repairs are properly made to car equipment.

"(2.) M. C. B. Rule 2 is modified as follows: (a) Loaded cars offered in interchange (except those having defective safety appliances) must be accepted by the receiving line which may either run, repair or transfer lading from car; (b) the repairs to car or transfer of lading is to be done by the railroad having facilities nearest available. If facilities are equally available by both railroads, the car will be moved to facilities located in the direction car is moving.

"(3.) If car is shopped for repairs due to: (a) old defects that existed before car was loaded; (b) lading requiring transfer or readjustment, account of not being in accordance with M. C. B. loading rules; (c) overload requiring transfer of lading; (d) not being within clearance dimensions over route it is to pass; (e) not meeting A. R. A. third rail clearance. In each case above mentioned, the facilities nearest to car will be used in making repairs to car or transfer of lading.

"(4.) Should the location of facilities require a receiving line to make transfer or readjustment of lading, the cost of such transfer or readjustment of lading will be billed against the delivering line as per Rule 2 of the 1918 Code. The chief joint or lead inspector will make report and forward to the head of the mechanical department of both railroads, showing all cars transferred or shopped for old defects, whose duty it will be to impose discipline for willful and inexcusable violation of the M. C. B. rules of interchange and loading rules, the same as instructed in Director General's Order No. 8 for the violation of the safety appliance law.

"(5.) Cars, whether loaded or empty, having safety appliance defects will have such defects repaired immediately upon discovery and will not be offered in interchange. If necessary to move car to shops for repairs of safety appliance

defects, it must be moved to shops of the company upon whose line it became defective.

"(6.) Empty cars offered in interchange, if in safe and serviceable condition, must be accepted.

"(7.) Bad order cars which previously had been delivered in bad order under load must be repaired by the road making transfer, if they have facilities and material; if not, the nearest repair point on any line, having material and facilities, should make the repairs.

"(8.) Owners must receive their own cars when offered home for repairs at any point on their line.

"Rule No. 92 is amended to read as follows: 'In rendering bills cars shall be treated as belonging to companies or individuals whose name or initials they bear, except that bills for repairs to leased cars or cars of other ownership shall be rendered direct if so directed in the billing instructions in the Official Railway Equipment Register.' "

ELECTRIC TOOL TEMPERING FURNACE

An electric tool-tempering furnace, which uses the barium-chloride and salt principle, is proving highly successful in the South Philadelphia works of the Westinghouse Electric & Manufacturing Company. The chief advantages of this type of furnace over those using gas, coke, oil or wood are constancy and ease of control of heat, cleanliness, equal heating of each atom of the specific part of the tool to be tempered, low cost of operation, and excellence of the finished work.

Electric Tool Tempering Furnace Used by the Westinghouse Electric & Manufacturing Company

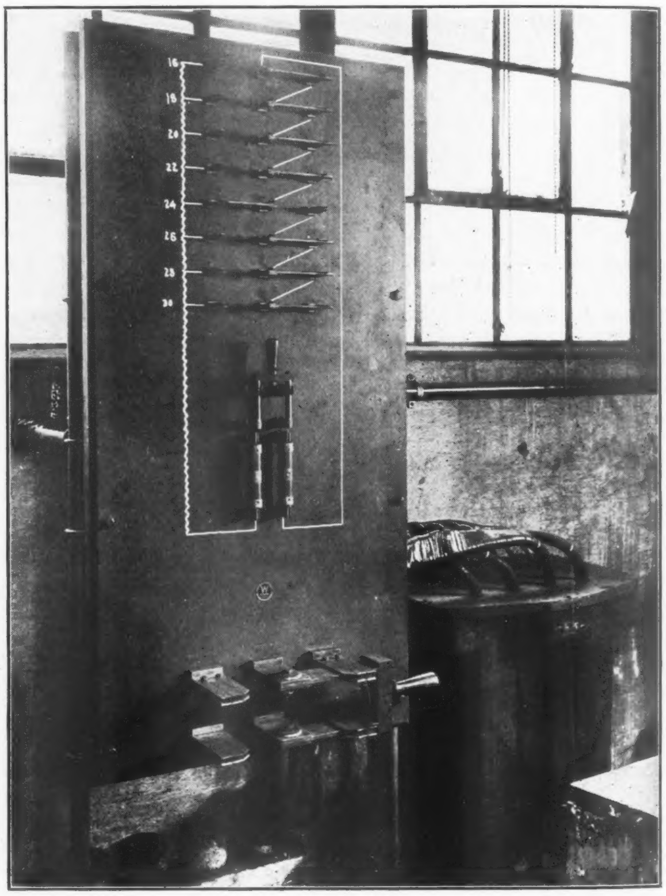
One of the photographs illustrates the simple construction of the furnace. The outer shell, a cast iron cylinder, is about 3 ft. high and 3½ ft. in diameter. This is packed with fire brick and an occasional layer of asbestos. The circular reservoir in the center which forms the operating part of the furnace is 12 in. in diameter and 14 in. deep.

The heat is supplied by two pairs of electrodes built in on opposite sides of the walls of the reservoir. The electrodes operate on a 16 to 30-volt alternating current circuit which is controlled by the switchboard and transformer shown in one of the illustrations. Carbon sticks are placed between the electrodes in the reservoir to complete the circuit.

The current is started on the 30-volt circuit. Salt is fed into the reservoir and when it is melted it acts as a conductor and completes the circuit. The carbon sticks are then taken out. A mixture of barium chloride and salt is then fed into the reservoir, the final proportion being about 60 per cent barium chloride.

When the temperature of the liquid reaches 1,425 deg. F. the voltage is lowered. The current regulation at the switchboard gives a quick and easy method of control so that the temperature of the liquid can be held at any predetermined degree of heat required for each specific tool.

The liquid, kept at one temperature, heats the tool uniformly from surface to center and eliminates soft spots in the finished tool, which is seldom possible when a tool is exposed to a direct or indirect flame.



Switchboard and Transformer for Controlling Alternating Current Supply to the Tool Tempering Furnace

The furnace throws off very little heat, a feature which meets with the approval of the workmen.

CONCRETE CARS IN THE NETHERLANDS.—The construction of concrete rolling stock for railroads is under way in Holland. Only the wheels, axles, buffers and couplings are made of steel. The weight of cars of the new type is said to be no greater than that of steel cars, the construction is simpler and cheaper and the upkeep light.

ELECTRIFICATION OF SWEDISH RAILWAYS.—The Swedish State Railway Administration has published a statement to the effect that after investigations regarding the electrification of the entire Swedish railway system, it has come to the conclusion that the plan can be carried out in 30 years at a cost of 192,000,000 kr. The advantages of electrification are that the whole of the power needed can be obtained from eight Swedish electric power stations, the traffic capacity will be considerably increased, and a great saving in staff costs will be effected. Sweden's enormous water power will, in the first place, be made available for this purpose.

Air Brake Association Meeting

Record Attendance at the Twenty-Sixth Annual Convention; Brief Account of the Proceedings

THE largest delegation of air brake men in the history of the organization gathered at the Hotel Sherman, Chicago, for the twenty-sixth annual convention of the Air Brake Association, which met May 6 to 9 inclusive. The first session was devoted to addresses by Frank McManamy, assistant director division of operation, United States Railroad Administration; W. J. Bierd, federal manager, Chicago & Alton; W. J. Patterson, bureau of safety, Interstate Commerce Commission, and F. J. Barry, president of the assocition.

PRESIDENT'S ADDRESS

President Barry in his address spoke of the past work of the association and mentioned its recognition by the Railroad Administration as showing the general recognition of the progress that had been achieved through the leadership of the organization. He urged that the association should continue its efforts to improve air brake service and to extend its sphere of activity, particularly by more active co-operation with the local air brake clubs, which offer an excellent opportunity for keeping in close touch with the problems arising in the maintenance and operation of air brakes. In closing he paid a glowing tribute to the genius of Walter V. Turner, whose work has been largely responsible for many of the most important advances in the art of train control.


F. J. Barry (N. Y. O. & W.)
President


T. F. Lyons (L. S. & M. S.)
First Vice-President


L. P. Streeter (Ill. Cent.)
Second Vice-President

ADDRESS OF FRANK McMANAMY

Mr. McManamy emphasized the necessity for promoting safety, efficiency and economy in the operation of the railroads under present conditions and pointed out how the Air Brake Association can help to secure these aims. He spoke of the need for a realization of the fact that the air brake is not merely a safety device, but is essential for proper operation with the heavy motive power and long trains now in use. He mentioned also the part that could be taken in reducing damage claims by the proper maintenance of the air brake equipment.

Mr. McManamy stated that in his opinion the neglect of brake equipment was too common on roads with low grades and that steps should be taken to remedy the condition. He recommended increasing the forces employed on air brake work and installing proper facilities at repair points where the equipment is overhauled. As the first essential for proper operation he suggested that more attention should be given to stopping leakage in the air brake system and especially in brake cylinders and retainer valves. He spoke also of the co-ordination of the mechanical associations under the American Railroad Association and the benefit that the Air Brake Association could derive by having its recommendation referred to the Mechanical Section and issued as mandatory instructions.

ADDRESS OF W. J. PATTERSON

Mr. Patterson outlined the work of the Division of Safety as it affects air brake matters and spoke of the importance of improving general air brake conditions throughout the country. He advocated the universal use of the incoming brake test as a means of securing better conditions. He also referred to the fact that hand brakes are used to control freight trains when descending heavy grades and said that it was the intention of the Division of Safety to require such practices to be discontinued.

INSTRUCTIONS ON FREIGHT CAR BRAKE MAINTENANCE

A paper giving detailed instructions for the maintenance of freight brake equipment was presented by Mark Purcell (Northern Pacific). The need for clear and definite instructions in printed form was shown by the tests of cars shortly after cleaning, which demonstrated that 21.3 per cent of the brakes cleaned were ineffective within one month. Two years of special inspection and instruction work reduced the percentage to 8.8 which still left a big opportunity for improvement. The need for detailed instruction is particularly urgent at the present time because of the large number of inexperienced men employed in the air brake department.

To avoid unnecessary switching and loss of car service, work should be done well when the cars are sent to the repair track and every opportunity taken to ascertain the condition of the brakes when on the repair track, house track and transfer track. The installation of air lines at such points was advocated as a means of reducing the cost

of brake maintenance, increasing car efficiency and expediting train movement.

DISCUSSION

The convention discussed at length the instructions for the testing and repair of certain parts of the air brake equipment, particularly with regard to brake cylinder leakage, retainer valve leakage and the lubrication of the brake cylinder wall. A special committee was appointed to pass on these questions and to prepare the instructions for publication as recommended practice of the association.

AIR LEAKAGE DUE TO DEFECTIVE HOSE COUPLINGS

A paper on Air Leakage and Money Wasted Through Failure to Keep Hose Couplings in Standard Gage, submitted by the Manhattan Air Brake Club, was presented at the Wednesday session of the convention. The paper emphasized the fuel waste due to brake pipe leakage and stated that examination of 1,600 freight cars showed that 35 per cent of the leakage existed in the hose couplings. Further investigation developed that it was difficult to find couplings in service that would pass the M. C. B. standard coupling gage test. Employees often use makeshifts to secure tight joints and at least one road has adopted a special gasket to eliminate hose coupling leakage. Some special types of gaskets submitted to railroads for approval when tested have required from 1,000 to 1,300 lb. to pull the hose apart. Such excessive strains fracture the hose and cause the brake pipe to shift, resulting in leakage. The paper recommended that the universal practice of gaging air brake hose couplings be included when periodic attention to air brake equipment is being given freight cars in shops or on repair tracks.

FUEL SUPERVISORS ADDRESSED THE CONVENTION

At the Thursday session L. R. Pyle and F. P. Roesch, fuel supervisors of the Central Western and Northwestern Regional Districts, respectively, delivered addresses in which they pointed out the way in which the air brake men could assist the Fuel Conservation Section. Mr. Pyle stated there has been a marked improvement in air brake conditions during the past few months, especially as regards brake pipe leakage. He urged the association to continue its support of the Fuel Conservation Section particularly by giving publicity to the magnitude of the waste of fuel caused by train line leaks. Mr. Roesch spoke of the necessity for reducing the cost of operation on the railroads now that normal conditions are being restored. As it appeared impossible to reduce wages or cut the cost of material, more efficient service was the only means of effecting economies that was left. He urged all the employees to justify the large increases in wages by greater efficiency in their work.

ADDRESS OF F. W. BRAZIER

At the Wednesday session F. W. Brazier, superintendent of rolling stock, New York Central Lines East, gave an inspiring address in which he counseled the younger members to devote their energies whole-heartedly to their work. He condemned the lax enforcement of the rules governing the maintenance of brake equipment to which he attributed in large measure the present unsatisfactory conditions. As an indication of the efforts the New York Central has made to maintain cars in good condition he cited the fact that as many as 800 men had been employed on air brake work alone and in 1917 the expenditure for freight car repairs had been over twice as much as for locomotive repairs.

OTHER BUSINESS

On Thursday morning a report was presented on damage to car brake equipment by thawing plants. The practice of thawing loads of coal and ore in buildings heated to a high temperature destroys the packing leathers, gaskets and air hose. The removal of the triple valves, hose and brake cylinder piston, before thawing, was recommended. No objection was raised to thawing by inserting steam pipes in the lading.

A paper was also submitted by the Northwest Air Brake Club advocating a braking ratio of 40 per cent and an inside release valve for caboose cars; the Central Air Brake Club also presented a report advocating large radiating surface between the compressor and the main reservoir.

The secretary reported a membership of 1,050 with a registration at the convention of 650.

The following officers were elected: President, T. F. Lyons, New York Central; first vice-president, L. P. Streeter, Illinois Central; second vice-president, Mark Purcell, Northern Pacific; third vice-president, G. H. Wood, Atchison, Topeka & Santa Fe; secretary, F. M. Nellis, Westinghouse Air Brake Company; and treasurer, Otto Best, Nathan Manufacturing Company. Newly elected members to the Executive Committee are C. M. Kidd, Norfolk & Western; R. C. Burns, Pennsylvania; H. A. Clark, Soo Line; and H. A. Sandhas, Central of New Jersey.

M. Purcell (Nor. Pac.) Third Vice-President

F. M. Nellis (Westinghouse Air Brake Co.) Secretary

Otto Best (Nathan Mfg. Co.) Treasurer

Eight-Hour Day in Italy.—Italian railway employees, according to a Havas press dispatch, have been granted by ministerial decree an eight-hour day with one day off in seven.

Automatics in Railroad Shops

Description of Typical Machines of the Three Primary Types; Set-Ups for a Variety of Jobs

BY M. H. WILLIAMS

On many railways it is found advantageous to blank out articles to a finished or semi-finished state in one central shop and ship them to other shops, a practice which results in economy when compared with manufacturing in each shop. The good results obtained with the automatic screw machine put it in a class that should be carefully considered when additional machine tool equipment is contemplated. This class of machine is being introduced into railway shops and is generally meeting with favor. Its field lies in the manufacture of smaller articles used in locomotive and car construction and repairs, such as are required in larger quantities than would be economical to make on turret lathes.

Contrary to general expectations, no serious difficulty has been encountered in operating these machines and it has not been found more difficult to secure operators for them than for the average run of machines generally used. While it is true that a certain amount of special talent is necessary for successful operation, in most shops there will be found one or more universal geniuses who will take naturally to machines of this nature and who with encouragement and a few visits to plants where similar machines are in operation will become experts and capable of camming, setting up or arranging for any work required. Where one expert is employed the machines may be run by operators who have not had extended experience. The operators rapidly acquire the knowledge necessary to set up and run these machines, one of the principal requirements being the grinding and setting of cutting tools, which is about the same as grinding and setting tools used on turret lathes.

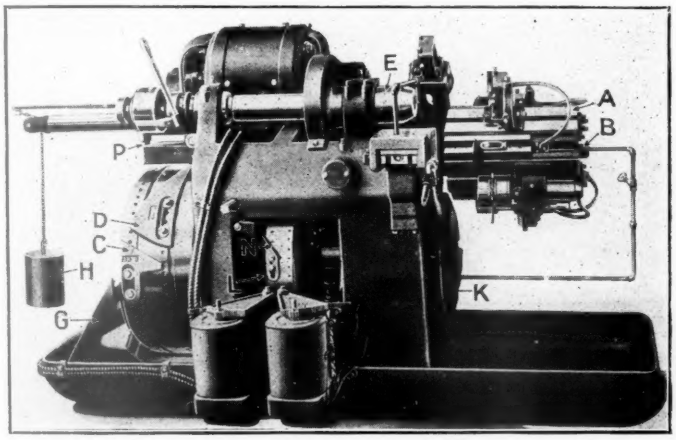


Fig. 1—Typical Single Spindle Automatic Turret Lathe

The economy of the automatic screw machine as compared with the turret or center lathe is due to the fact that one operator can run from two to four machines, each of which will turn out work as rapidly as a turret lathe and much more rapidly than a center lathe. The automatic screw machine is quite similar to the turret lathe, with the difference that on the automatic machine the various operations are controlled by cams and on the turret lathe by hand.

The machines best suited for the first installation in railway shops may be divided into three classes: the single spindle machine suitable for bar work, in which one bar is worked on at a time, Fig. 1; the multiple spindle machine, on which four or more bars are worked on at one time, Fig. 2; and the automatic chucking machine, Fig. 3, having one spindle and used mostly for machining castings and forgings.

The machines illustrated have been selected as representative of their class and for the purpose of explaining the general principle of operation. There are several makes and designs that are extensively used, all of which, together with those illustrated are very popular. Selection must necessarily be governed by the volume of work a particular shop is called on to turn out, cost and other considerations. The kind of work suitable for each class of machine and the general principles of operation and set-up will be considered separately.

THE SINGLE SPINDLE MACHINE

This class of machine, shown in one form in Fig. 1, is very useful for railway work on account of the ease with which it may be cammed and tooled, or as it is generally termed "set up." For the small batches of articles, such as valve motion pins and bushings, set screws, bolts or cap screws having finished surfaces, boiler patch bolts, turned air brake pins and similar articles, this machine will be found very desirable for work made in too large quantities for economy on turret lathes and in too small quantities to justify setting up a multiple spindle automatic.

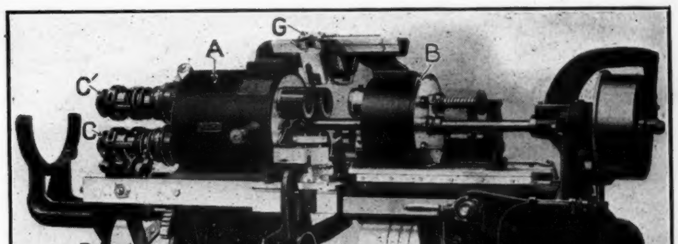


Fig. 2—Multiple Spindle Automatic Screw Machine

The machine which is shown in Fig. 1 is motor driven, and practically all classes of automatic machines may be driven by motor, which is generally considered an advantage. There are several designs of single spindle machines on the market, all of which work on one general principle, therefore, a description of the machine shown will be for the purpose of explaining the various operations. This description will apply in a general way to any single spindle machine.

This type of machine generally has a four hole or face turret to which the various cutting tools, dies or tap holders, shaving tools, etc., are secured. To those accustomed to turret lathe practice four tool holders may not appear enough. In practice it is found ample on account of combining several cutting operations in one tool holder, as

will be brought out later. On the machine shown the tools are held on a four sided horizontal turret that is indexed from one position to the next in succession as each tool is required, the active tool being at the top. Each tool is mounted on a slide that is moved to the left by cam *D*. Fig. 1, secured to the cam drum at the left of the machine. This cam works on a roller attached to a rod which connects with whatever slide is at the top, the slide being moved back to the right by cam *C*, also acting on the roller.

Other forms of machines have a round turret revolving around a vertical shaft similar to turret lathe construction, while others have round turrets revolving around a horizontal shaft. On all of these machines the turret and slide are moved to the right and left by cams acting on a roll secured to the turret slide. When the turret is moved to the right it is indexed to the next position.

The cam shaft shown in the lower frame on this machine, and the corresponding cam shaft on practically all single spindle automatic machines, makes one complete revolution for each piece manufactured. To the cam drum or cam disks secured on this shaft the various cams for controlling the operations of the machine are secured. This cam shaft is driven on the belted machines by a separate belt, the pulleys or gears being changed to obtain different speeds. On motor driven machines the speed is often changed by rheostatic control. An explanation of the uses for the various cams will be made in order to give an idea of the work involved when changing from one job to another and not for the purpose of explaining the design of the cams.

With the machine shown in Fig. 1 the slide on the turret face is made to travel in a horizontal direction by cams *C* and *D*, mounted on the left hand drum, working on a roll secured to bar *B*. The cam *D* is for feeding the turret slide up to and over the work and cam *C* for the reverse direction, the length from the right to the left hand side of these

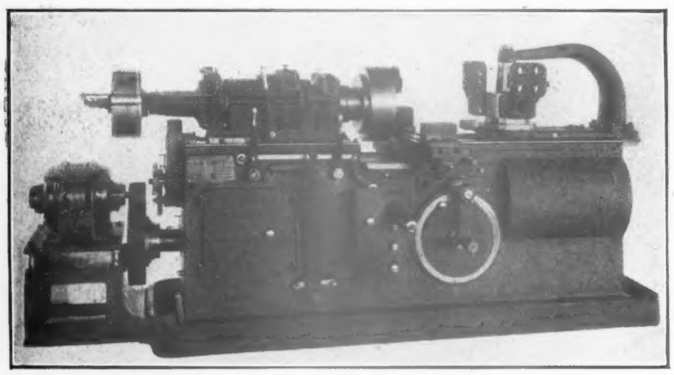


Fig. 3—An Automatic Chucking Turret Lathe

cams being sufficient to cause the turret to travel the maximum length the machine is designed for. With the machine in question the turret is indexed by separate mechanism. On other forms the indexing is done when the turret is at its extreme right hand travel, similar to hand screw machines. Cams F, F^1 (at the right, but not shown in the illustration) on the same drum are for tightening and loosening the chuck or collet, forcing the spring collet into the inclined spindle head or nose *E*. This does not differ to any great extent from turret lathe practice. The cam *G* on the same drum is for feeding the bar, and in this case the cam draws the feed tube backwards over the bar, the weight shown drawing on the chain which forces the feed tube to the right and feeds the bar as soon as the pin *P* passes over the peak of the cam. The cam disk *K* at the right of the machine is cammed to operate the front and rear cut-off tool holders. The middle drum hás cams *N* and *O* (one of which is not shown) for controlling the direction of the rotation spindle. The pins *L* on this drum are for controlling the speed of rotation of the cam drum shaft and perform the following operation.

The speed of rotation of the cam drum must of necessity be slow while the tools are cutting. In order to increase output a speeding-up arrangement is applied to the cam drum driving mechanism, by which the speed of drum rotation is very much increased, often 70 to 1, and which causes the machine to go through the non-cutting operations, such as the travel over the surface of cutting cam *D* previous to the tools in the turret coming into operation, backing off and indexing the turret, feeding stock, etc.,

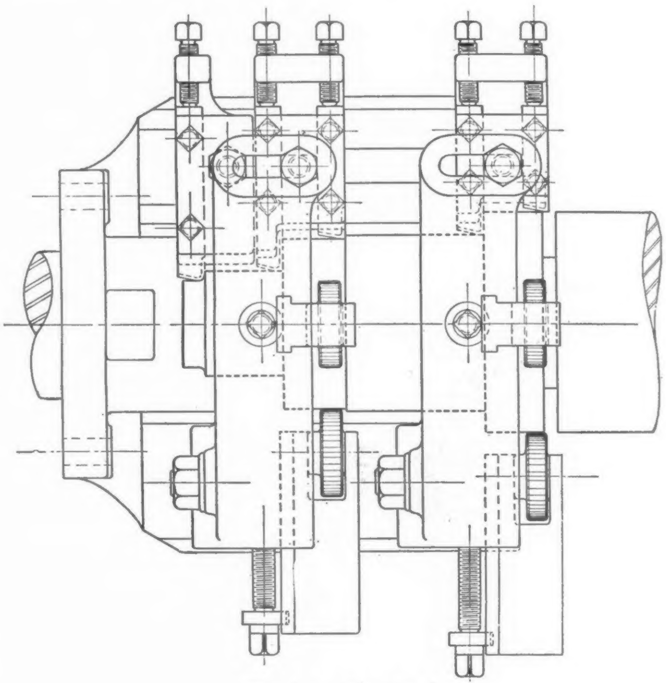


Fig. 4—A Box Tool

at a rapid rate. When tools are cutting the speeding-up device is non-operative and the cam shaft travels at a slow rate. This device performs practically the same operation as the operator on a hand screw machine, who after a cut is completed quickly backs off the turret to the rear position for indexing and bringing it up to the work. The speeding-up device is controlled by pins *L* bolted into a groove cut in the side of the cam and may be readily altered by simply loosening and tightening a nut. This makes it possible to eliminate lost time between cutting operations and to do practically the same as the operator does on the hand screw machine.

SETTING UP A NEW JOB

The cams for the two cut-off rests bolted to the right cam disk *K* do not require much changing for different jobs, as cutting off is generally the last operation. For some work it is necessary to form with one of these cut-off rests before the piece is ready to cut off, which will make a change of cam necessary.

The cams for feeding the stock and chucking on the drum at the left are generally permanently located and are rarely altered. The reversing cams *N* and *O* for rotation of the spindle must be altered when tapping operations are performed or a solid die is used. This operation is readily performed by removing the bolts and setting to new location. The cams or pins for the hurry operation *L* must be changed for each job. This requires only the loosening and tightening of a nut. The cams for feeding the turret will be considered later.

The tools used on the single spindle machines are comparatively simple, not differing greatly from tools used on hand screw machines or turret lathes. The principal tool for average work is the box tool in some of its forms, one form being shown in Fig. 4. These tools are well understood by those familiar with hand screw machines or turret lathes. On the automatic it is customary to make use of a number of cutting tools in one box in order to turn to various sizes and shoulders in one operation. These tools are found convenient of adjustment for various sizes and shapes of work. The cut-off tool, drill and reamer holders and forming tools are very similar to those used on turret lathes. The die holder may be similar to that used on turret lathes, but the self-opening and closing die is generally preferred, the machine and die being arranged to open

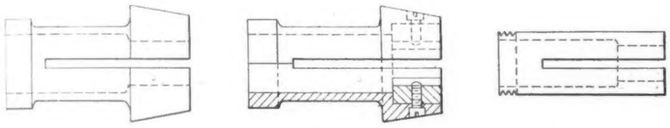


Fig. 5 Fig. 6 Fig. 7
Spring Collets and Feed Finger

and close at the right moment. All these tools are regularly supplied by the makers of the machines.

For each size of stock it is necessary to use the correct size of spring collet, as shown in Fig. 5. Those for the smaller machines are made from one piece of tool steel very accurately machined and split as shown. They are then hardened and ground to the correct size in the bore where the stock is clamped and also on the outside where they fit the chuck nose. This is a somewhat difficult operation, requiring experience and proper appliances, and can best be done by the makers of the machines. For the larger machines a spring collet or holder is used into which pads may be held by screws, as shown in Fig. 6. With this arrangement one or two holders will answer for any size of bars within their range. It is necessary, however, to obtain pads for each size and shape of bar.

The feed fingers shown in Fig. 7 are made similar to the spring collets. For the smaller machines they are solid and for the larger machines are used with pads. These, like the two forms of spring collets, can best be purchased from the makers. The collets and feed fingers will last a long time and are not an item of great expense. It is necessary to use collets made correctly for each size of round, square or hexagon stock, as their range for satisfactorily holding bars is rarely 1/32 in. and unless properly made it is not possible to obtain satisfactory work or output.

CAMMING FOR AVERAGE JOBS

Before going into the question of the laying out of cams it may be well to consider the conditions of camming and set-up generally found in railway shops, having in mind such work as may come within the range of the class of machines in question.

When purchasing a machine it is customary to have the maker cam it for one or more jobs and also supply an entire equipment of tools for the more common pieces to be made, the result being that the machine is received set up in the most approved method and will be an object lesson in the art of camming. After obtaining a few machines properly cammed it is surprising how many jobs may be done without changing cams, and how quickly changes may be made from one job to another. As previously pointed out, the cams for feeding and chucking the stock rarely require changing; the speeding up cams are set by altering their position with a wrench; the cut-off cams do not require frequent changes. It then comes down to the feed cams for the turret, which will have to be changed when a radical change is made in the class of work.

Assume that a machine has been purchased set up to make cup pointed set screws, say 3 in. long and ¾ in. in diameter, made from ¾-in. square stock, as shown in Fig. 8. A possible set-up would be as follows: The tools used in the turrets could be made up of a stop for limiting the length of bar fed out, a box tool to turn the threaded portion of the screw and at the same time reduce the pointed end, a drill to cup the point, and a die for threading. A tool would be placed in the front cross slide to break off the corners of the head and neck under the head and the cut-off tool in the rear or top cross slide. For holding the stock a collet having a ¾-in. square hole would be used and also a feed finger having a similar hole.

The cycle of operations is as follows: The feed finger is pushed forward to the right by the weight and carries the bar until the end of it strikes the stop set on the turret, which arrests its travel. For this operation the feeding and cams controlling the left hand travel of the turret must be set so that the stop meets the bar at the right moment, it being customary to design the stop cam with a short straight surface, which will allow the turret to remain stationary while the bar is feeding and the chuck is closing. The cam for the collet chuck now forces the collet tube forward, which causes the collet to close on the bar and lock. The turret is now forced to the right and is indexed to the next position by one of the backing off cams *C*, Fig. 1. It is then caused to travel to the left by work cam *D*. All of these operations are performed with the cam drum revolving at a rapid rate by the adjustment of the speeding-up device. When the box tool is within about ⅛ in. of the end of the bar the speeding up device is thrown out of operation by the speeding pins *L*. The turret then travels at a speed suitable for taking a cut with the box tool, which then machines the threaded body of the screw and also reduces the end and points. After this operation is completed the speeding up device is set in operation and about this time one of the reversing cams backs off the turret and causes it to go through the same operation as has been explained until the drill is about ⅛ in. from the point of the screw. The cam drum then again slows up until this operation is completed.

Threading is done in identically the same way. If a solid die is used the spindle of the machine would be reversed at the proper moment by the cams for that purpose. The cut-off cams then cause the tool for breaking off corners of the head to feed in and do its work, and also at the

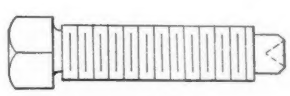


Fig. 8
Cup-Pointed Set Screw

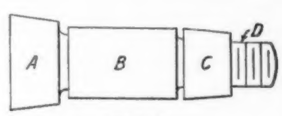


Fig. 9
Valve Motion Pin

same time the cut-off tool is cutting off the bar. When the set screw is completed it falls into the base of the machine or onto a chute and drops into a box. The cam drum now goes to fast speed, the chucking cam loosens the collets, the bar feeds, and the various operations are gone through again.

The set-up just described could be modified to save time by holding the drill for cup pointing in the box tool, in this event the turning and cup pointing would all have been done at one time and the separate operation of cup pointing done away with; the third position of the turret could thus be passed over while the cam drum is revolving at a rapid rate.

Set screws are required of various lengths and diameters

for locomotive repairs. If necessary to make to lengths differing from that mentioned above the operations of altering the machine would not differ greatly from those of changing a turret lathe. To change from the 3-in. screw above mentioned to a 2-in. screw will require the following changes. The stop for gaging the length of stock must be set out one inch, the cutting tool in the box tool for reducing the point adjusted, the drill for cup pointing moved out one inch and the speeding-up cams or pins relocated to throw the same out of operation at a later period, all of which may be done in a few moments. If it is necessary to make a longer screw the cutting tools would be reset in the opposite direction from that mentioned and the speed-up pins reset. For manufacturing bolts from hexagon or square stock it would be necessary to change the collets and feed fingers and alter the tools on the turret faces. The cams used for

Fig. 10
Rod Bushing

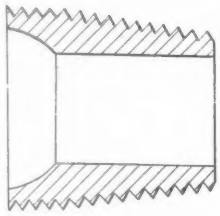


Fig. 11
Staybolt Sleeve

set screws would answer without changing. Shifting from set screws to bolts will involve about the same work as changing on a turret lathe.

A NUMBER OF TYPICAL SET-UPS.

Next it may be well to consider work such as valve motion pins or bolts, as shown in Fig. 9. This pin may be made from cold or hot rolled mild steel of the nearest diameter kept in stock. The cycle of operation of manufacture would be as follows: The stock would be fed out against a stop and the collets tightened. Next a box tool would rough turn the diameters *A*, *B*, *C* and *D* as shown in Fig. 9, except that the tapers would not be made in this operation. For roughing these four diameters four cutting tools would be placed in the box tool, each set to cut to the proper diameter and correctly spaced to allow for the correct distances. The next tool may be a finishing box tool in which are held two broad faced shaving tools for shaving the taper portions, a plain tool to turn the body *B* to correct diameter and also a center drill for centering the end of the pin. The remaining turret face would be taken up by the threading die. In the front cut-off rest would be placed two tools for necking, as shown, should this be desired, the cutting off being done by the rear cut off.

The stop, chucking and feeding cams would be identical with those used for the set screw. Under most conditions the same work cam *D* would be used. However, on account of heavier work and more tools cutting it may be desirable to alter this cam to provide a slower rate of feed, which would involve removing the two bolts shown, removing the cam and applying a new one. A reasonable amount of care must be taken to locate the new cam similar to the one removed. The same operation would possibly also be necessary for the next cam, on account of the center drilling, which is a delicate operation; it may be desirable to reduce the angle of the cam near the end of the cut in order not to crowd the drill. The operation of threading would be similar to that on the set screw. The cut-off cams would be the same. The speeding up cams would be set to speed up at completion of each cut and slow down at the start of each cut, as has been explained.

As another example let it be assumed that it is desirable to make bushings such as are used in valve motion levers or rods, shown in Fig. 10, from solid bar stock. The operations of feeding the bar would be similar to the above. In the second position of the turret the operations would be those of drilling and rough turning the outside, both of which may be done at one time by a drill and turning tool held in the box tool. If accuracy is desired, an inside and outside turning tool may be used on the next turret face, inside turning of the hole being for the purpose of insuring that the hole is concentric with the outside and to correct trouble from the drill not running true. If accuracy is not necessary, as would be the case where these bushings are to be finished later to fit worn levers, this operation may be omitted. The next operation would be that of reaming the hole and cutting off. On account of the drilling which may be for a comparatively large hole, it will be necessary to employ a slow feed work cam *D*, Fig. 1, the changes of which would be similar to those previously explained.

For making flexible staybolt sleeves, Fig. 11, the operations may be those of drilling and forming the outside at one time, threading the taper end and, in the last position of the turret head, threading the straight portion and cutting off. This would require a slow feed cam for the drilling and require relocating the cut-off cam for the outside forming, which should be done at the same time as the drilling. This will involve in most machines the drilling of additional holes in the cut-off cam disk. The threading could be done with the regular work cams. On account of two dies it would be necessary to add a pair of cams to take care of the second reversal of the spindle, and the speeding-up cams would also have to be properly set. This describes only one of the many methods of setting up for this much used article. In the larger shops it is customary to make these sleeves on multi-spindle automatic machines, where the output will be greater. The countersinking for the head of the staybolt must be a second operation.

Much space could be used in dealing with the proper angle and design of cams in order that the greatest output may be obtained. On this class of machine it is the custom of the makers to supply cams known as slow, medium and fast, which will generally meet all requirements for railway work. To go too deep into this phase of the subject would only complicate matters and it is a question if anything would be gained in the long run.

When purchasing a machine it is customary for the maker to cam for certain jobs. From the original set-up a study of cams and tools may be made that will serve as a guide for future jobs of a similar nature. That is, suppose a machine is set up for the set screw, Fig. 8, where the cam for feeding the box tool is what is known as medium, or in the case of the bushing, Fig. 10, a slow cam is used for drilling the bushing. If these work satisfactorily a record may be made of the set-up and similar cams used for jobs of a similar nature. By obtaining a supply of cams of various degrees of speed about any job encountered in railway shops may quickly be set up. The cams used on most single spindle machines are made of iron or steel castings and are comparatively cheap. While the speed of output may not be all that an expert may desire the results for the month will be found satisfactory if attention is given to reducing the lost time by proper setting of the speeding up device for the cam drum.

Making use of as many cutting tools in one operation as possible results in time saving. Never make use of two faces of the turret if by combining the tools the operations may be done on one face. This is a question of judgment on the part of the employee having charge of the machine.

The single spindle machines are made in various forms and designs, having rod capacities of from ¼ in. to 5 in.

For railway work, except in the largest shops, there is not enough work to keep the smaller machines fully employed. As a general proposition machines smaller than 1½-in. rod capacity will not meet with favor. However, the general run of work must govern the size of machines selected.

THE MULTIPLE SPINDLE AUTOMATIC MACHINE

The multiple spindle automatic machine, shown in Fig. 2, differs from the single spindle machine in that four or more bars are operated on at one time and as a result a greater output is obtained. Its principal use is for making articles in large numbers at one time; it begins where the field of the single spindle automatic machine leaves off.

The machine shown has four live or work spindles and will serve as an illustration for describing any class of multi-spindle machine, some forms having five or six spindles. However, they all work on one general principle.

With the machine shown, each of the four bars when being worked on is chucked and revolved in one of the work spindles C, C^1, C^2 and C^3, only two of which are clearly shown. These spindles have their bearings in a drum that is indexed on the quarters. That is, the spindle shown at C next indexes to position at C^1 then to C^2 and so on. The stock is always fed and chucked in the spindle while in position C, the operation of feeding stock and chucking being controlled by cams on the cam drum D. These operations are similar to those of the single spindle machine.

The turret, or more properly speaking, the fixture for holding the cutting tools, dies, taps, etc., is shown at B. This is mounted on a slide that works longitudinally in a horizontal plane and is controlled in its movements by a roll attached to it, which is operated on by the cams on cam drum E, the number of tools in this tool holder corresponding to the number of spindles of the machine. The cut-off and cross forming tools are controlled by cams on cam disk F. There are also special shaving tools at the top of the machine shown at G.

HOW THESE MACHINES OPERATE

When setting up this machine a bar is passed through the spindle shown at C and the chuck and feed finger properly set. The machine is then indexed by hand to the next position, so that this spindle is rotated to position C^1. The second bar is then placed in the spindle now at C and the chuck and feed finger for this spindle properly set. The same operation is gone through with for the remaining two spindles. The machine may then be started, when all spindles and bars will revolve.

When machining, the four tools in the turret each performs a certain operation very similar to the single spindle machine, except that with this form of machine the first tool performs a certain operation, which for the set screw may be to turn the threaded portion for a part of its length. The live head then indexes and this bar is passed on to the next tool, which may finish the turning and pointing. In the meantime the bar just fed is having the first operation performed on it. The head then indexes and the first bar is threaded and the second and first bars are turned. In the last position the bar is cut off. It will be noted from the above that each time the tool holding turret advances a complete piece is made, the time to make a piece being that of the longest single operation. The method of setting the tools is very similar to the single spindle machine.

The operation of indexing the live spindle drum, threading and revolving the live spindles would require a lengthy description and will therefore be omitted; suffice it to say that these operations have been carefully worked out and give very little trouble.

The cam drum shaft makes one revolution for each piece manufactured, that is, the cam drum makes four revolutions to one complete revolution of the live spindle drum. The cams are very simple, consisting of the customary cams to open and close the chuck and the bar feeding cams, which are mounted on cam drum D. Like those on the single spindle machine, they are rarely changed. The tool turret is controlled by cams mounted on cam drum E, which are generally changed when a job is set up, which varies to any great extent from the previous job, this being done to obtain greater output. The cut-off cams on disk F do not require frequent changing. In addition, the machine has the customary speeding up device for rapidly revolving the cam drum during the non-cutting operations.

As a whole this class of machine is not difficult to set up and is readily understood by persons having a knowledge of automatic screw machines in general. It is naturally more difficult and more time is required to set it up than the single spindle machine on account of the greater number of chucks and feed fingers that are used, each of which must be adjusted to the correct tension. The cutting tools do not differ greatly from those used in the single spindle machine and require about the same time to set up. With the multi-spindle machine it is necessary to employ one set of chuck and feed fingers for each spindle, amounting to four or more sets compared with only one for the single spindle machine. On this, as on the single spindle machine it is often possible to change from one job to another without changing the cams or, possibly only a change of the cam that controls the tool holding head.

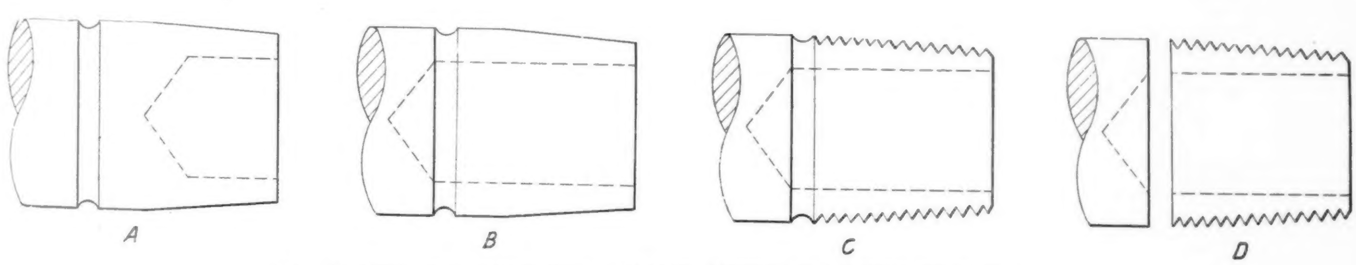


Fig. 12—Successive Operations In Making Sleeves for Flexible Staybolts

SOME MULTIPLE SPINDLE RAILROAD SHOP JOBS

In railway shops there are a number of articles that can be made to good advantage on these machines. Their selection should be confined to articles made in large quantities where frequent changes or set-ups will not be necessary. One job these machines are often used on is the making of sleeves for flexible staybolts, as shown in Fig. 12. A description of the different operations when making this piece may be of interest and will serve as an illustration for any similar job. Assume that the four bars are in the machine and ready to start. The bar in position C is fed against a stop that is moved up in front of the bar at the time of its feeding. After the bar has been tightened in the chuck the stop lowers out of the way. The cutting tools then advance to the left and drill a hole for a part of the distance and at the same time a front forming tool is cutting

the outside of the bar to the form shown at *A*. When this operation is completed the tools back away and the spindles are indexed a quarter turn. The second bar is now fed in the spindle in position *C*. The bar previously mentioned has now advanced to the next position, where the hole is drilled the full depth by a second drill, as shown at *B*, and at the same time the bar just fed is drilled and formed on the outside. The tools now back off and the third bar is fed and chucked. In this position the first bar is threaded, which for this particular piece is done by two dies held in one holder, one being for the straight thread and the other for the taper thread, as shown at *C*. While the threading

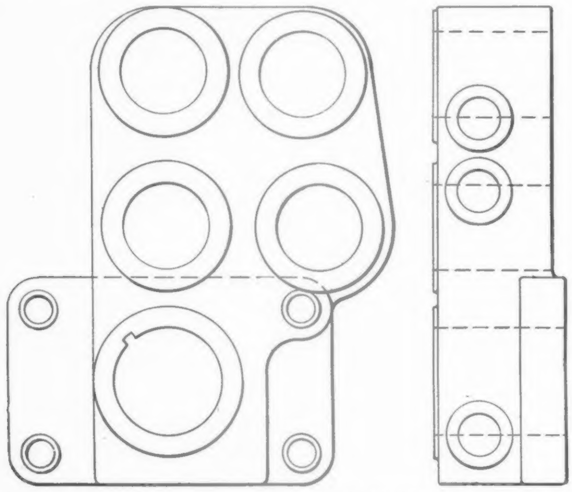


Fig. 13—Turning Tool Holder

is going on the two operations explained are also going on on the bars following. The tools now back off and the first bar indexes to the fourth position, where the sleeve is cut off, as shown at *D*, and at the same time the operations that have been explained are being performed on the succeeding bars. As a result, each time the tools advance a complete piece is made. If it is necessary to make a longer or shorter sleeve the cutting tools and speeding dogs should be changed. A change to a larger or smaller sleeve will also involve changing collets and feed fingers, but for the average length of these sleeves it would not be necessary to change the cams. To make set screws or similar articles would probably require a complete change of collets, feed fingers and cams on the drum for feeding the tool slide.

THE AUTOMATIC CHUCKING MACHINE

The automatic chucking machine, shown in Fig. 3, is used mostly for machining castings and forgings. It differs from the automatic screw machine principally in the omission of automatic chucking and feeding of the stock, the turret travel and indexing, the cut-off, forming and speeding-up of the cam shaft being operated by cams. The articles to be machined are chucked in regular lathe chucks or special chucks or holders and follow practices very similar to holding castings or forgings in center lathes.

In operation the piece to be machined is chucked and a starting lever is shifted which throws the cam shaft revolving mechanism into operation. The machine then goes through the various operations necessary to complete the piece, being controlled entirely by the cams. When the piece is completed the mechanism for revolving the cam shaft is thrown out of operation and remains inactive until the operator adds a new piece and starts it again.

The method of camming and setting up this form of machine is very similar to that used on the single spindle automatic screw machine and a description would be largely a repetition of what has already been said; therefore this will not be considered except where it is necessary to note differences.

CAPACITY RANGE OF CHUCKING MACHINES

These machines are made in various sizes and forms, the largest being capable of machining work up to about 16 in. in diameter by about 12 in. long. Their principal use in railway work is the manufacture of special cocks and valves used on locomotives, air pump piston heads and packing rings, nuts for side and main rods, oil or grease cups made from forgings or castings, parts for metallic packing, water gage parts, boiler fittings, piston rod and other nuts, piston packing rings and parts, nuts for flexible staybolts, knuckle pins and bushings, or generally speaking, any article finished from castings or forgings within the size capacity of the machine, which are made in quantities of 50 or more at a time.

The tools used on these machines differ materially from those used on automatic screw machines, principally because the work is larger and made from castings or forgings. These tools in many respects resemble those used on the larger turret lathes for similar work. When the machines are purchased they may be equipped with various forms of tool holders, turning tools and devices, which make it possible successfully to machine a large variety of work without designing special tools. The cutting tools are generally made from square high speed steel, similar to the bits used in lathe tool holders.

One form of turning tool holder, shown in Fig. 13, is used quite extensively. This, as shown, may be secured to the face of the turret by four bolts, the outer face being drilled and reamed to take tool holding bars such as those

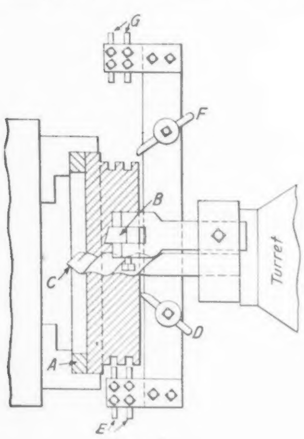


Fig. 14

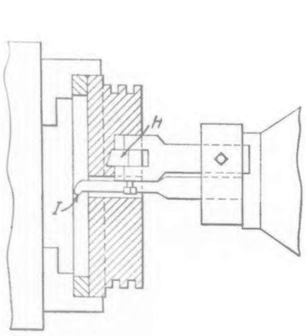


Fig. 15

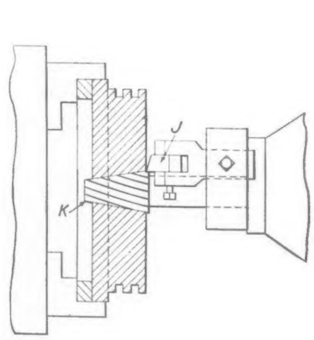


Fig. 16

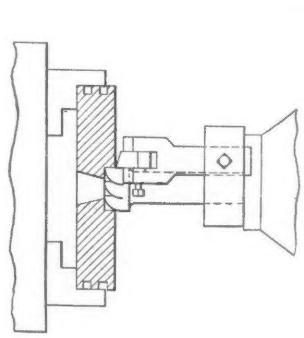


Fig. 17

Operations in Turning an Air Pump Piston Head

shown in Fig. 18, which in turn hold the high speed cutting tools. The holes for the tool holding bars are spaced to varying distances from the center line of the lathe spindle, which makes it possible to select a hole suitable for practically any article to be made. It is customary to make use of one, two, three, or more of these holes and tool holding bars at one time, in order that a corresponding number of cutting tools may be in operation at one time, each machining a separate diameter or face. A good illustration of this is the valve bonnet shown in Fig. 21, where the shoulder, threaded portion and end are all machined at one pass of the turret. Drills and reamers are held about the same as in turret lathes. It is customary to use the self-

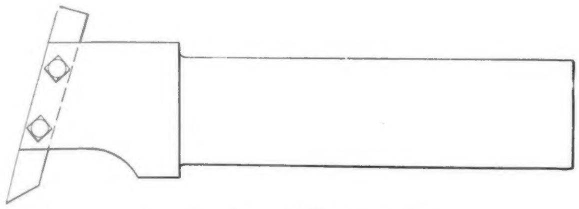


Fig. 18—Outside Turning Tool

opening die, as these machines are not usually arranged for reversing the direction of the spindle, and collapsing taps are also used for the same reason. These dies and taps give very good results. The cross facing is done with ordinary tools held in tool posts similar to lathe practice. Special tool holders and appliances are designed for various jobs, making it possible to machine almost any article required that comes within the range of the machine. It is a question of having a large enough run of one kind of article to warrant the designing and making of these special appliances.

TYPICAL CHUCKING MACHINE WORK

A few illustrations will be given showing jobs suitable for the machine in question. A fair sample of larger work is the 9½-in. air pump piston head, Fig. 14. There are numerous ways this job could be set up. For the comparatively small number called for at a time the set-up as outlined below may be followed and is advocated because it will involve only a few tools in addition to those which would be required to make the same piece on center lathes. The casting would be chucked for the first operation, as shown in Fig. 14, having it supported as far away from the chuck face as possible while assuring a satisfactory hold and permitting the entire outside face to be machined at this one chucking. It is backed up by ring *A* to prevent shifting and admit of quick chucking. The tool *B*, for turning the periphery of the head, and the drill *C* are held in a tool holder secured to one face of the turret. As the turret advances the drill bores the hole for the piston rod and the outside is rough turned. As soon as these operations are completed far enough for the tool holders and turret to get out of the way the front facing tool *D*, held in the cross slide, starts to rough face. Generally the cams may be set so that these two operations are going on at one time. In the front cross slide are also held two tools, *E*, *E* for roughing out the grooves for packing rings and which come into operation about the time the facing is completed. The front cross slide now backs off and the rear slide, in which are set a finish facing tool *F* and two finishing tools *G*, *G* for packing ring grooves, comes into play and completes these operations. These latter tools are held with the cutting edge downward. These now back off and come to rest to clear the casting. The cam shaft now goes into high speed and causes the turret to index and advance until the tools are about ¼ in. from the work when the cam shaft goes to slow speed and the finishing tool *H*, Fig. 15, finishes the outside diameter of the casting to correct size and at the same time a boring tool *I* bores the hole true for the purpose of correcting any inaccuracies that may have developed on account of blow holes or the drill not running true. The cam shaft now goes to fast speed and indexes the high speed continuing until the tools shown in Fig. 16 are ready to cut, when it slows down and tool *J* in the tool holder breaks off the corner while at the same time the hole is reamed by reamer *K*, held in a floating holder. When this is completed the cam shaft goes to fast speed and indexes around to the starting position, where it automatically stops, until the finished piece is removed and replaced.

The second side is finished in a very similar manner, as shown in Fig. 17, the front facing tool, in the cross slide shown in Fig. 14, the rear facing tool rough facing the piston, while the rear tool does the finish facing. A tool in the tool holder on the turret breaks off the corner. If necessary to counterbore for a piston rod nut, a counterbore is also held in the turret and operates at the same time. The second side of these pieces only takes up one face of the turret, the remaining faces being indexed and passed over at fast speed until the machine comes to starting position.

This set-up, while not ideal for great output, is one that may quickly be made without much in the way of tools not supplied with the machine. The two front and back tools to cut the packing ring grooves require a special holder which is not expensive. The facing tools are held in regular toolposts on the cross slides which may be supplied as part of the machine.

The cutting tools are similar to lathe tools used for similar purposes. The drill is held in a holder in one of the turret holes, the inside turning tool being held in a similar manner. The outside turning tool is shown in Fig. 18, the nature of which has already been referred to. For accurate reaming it is advisable to hold the reamer in a float-

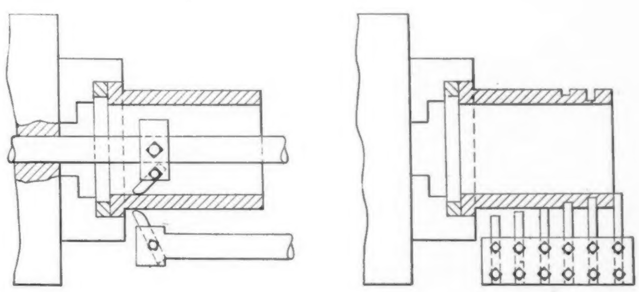


Fig. 19 Fig. 20

Turning Air Pump Piston Packing Rings

ing holder. If necessary to tap the head the inside turning and reaming may be omitted and a tap substituted.

The regular cams supplied with the machine may be used for the turret. The cams for the cross slide would have to be set to insure that the cross facing does not interfere with the turret tools, which is a comparatively simple operation. The time for making this piece would be less than is required to make it on a center lathe on account of the tools being set to size on this machine and requiring considerable resetting and adjusting when made on a center lathe. Considering the fact that one operator may attend to three or four of these machines, their economy is self-evident.

Air pump piston packing rings may readily be made on these machines. The general custom is to make the castings in pots which are held in the three-jaw or a special chuck and about the same practice is followed as in chucking cylinder packing. When machining, the outside and inside of the pot is turned at one time by tools held in a fixture se-

cured to the turret face and provided with a pilot bar passing through a bushing in the chuck for the purpose of steadying the fixture. The outside is then finished with a second similar tool, also guided with the pilot bar as shown in Fig. 19. The rings are then cut apart by a number of cutting off tools, as shown in Fig. 20. This method is followed very largely by automobile manufacturers.

Globe valve parts may also readily be finished on this class of machine, the tooling operations not differing materially from turret lathe practice, except that the self-opening die,—generally hand-closed,—should be used. A valve bonnet will be used as an illustration, shown in Fig. 21. This piece may be held in a three jaw chuck if such device is suitable, or if of a special shape, special jaws that conform to the shape of the bonnet may be necessary. The first operation would be to turn at one time the outside of the shoulder, the threaded portion and the end, with the tool held in the tool holder supported from the turret. At the same time the hole would be drilled and countersunk by a combination drill and countersink held in the same tool holder. After this operation is completed the piece would be necked and the shoulder rounded over by tools held in the front cross slide. The hole would then be finish reamed by a reamer held in the floating tool holder and the countersunk seat may be finished by combining the reamer and countersink. After this the piece would be threaded. Should this piece require inside threading a tap may be substituted for the last reamer, in which event the ordinary form of square shank tap may be used, which would be held in a square socket and allowed to feed entirely through the piece and draw out of the socket; the tap would remain in the bonnet, to be removed by the operator and replaced in the socket when he takes the piece out of the chuck. Other parts for globe valves may be made in a similar manner and, generally speaking, require only such special tools as would be needed on a turret lathe.

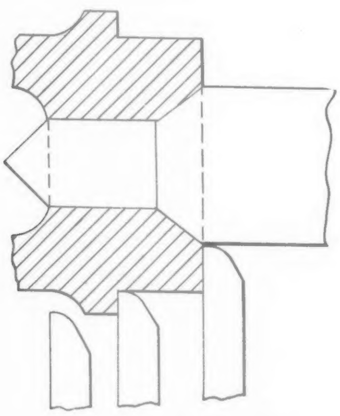


Fig. 21—Valve Bonnet

MANAGEMENT OF AUTOMATIC MACHINES

There is some difference of opinion as to the speeds and feeds at which automatic screw machines should be operated. Fast cutting speeds and feeds naturally turn out more work per minute. To offset this the cutting tools dull more rapidly which makes it necessary to stop the machines for the purpose of sharpening the tools. Slower speed results in smaller output per minute, but also in less delay. Generally speaking, for soft steel where good, high speed steel cutting tools are used and also a good grade of cutting oil, a cutting speed of 100 ft. per minute and a feed of 1/200 to 1/50 in. per revolution can be maintained without too frequent sharpening of cutting tools. By observing the speeds on a few jobs made from various grades of material, a fair estimate may be made as to speeds for new jobs and data secured for selecting cams and setting spindle speeds. These machines are equipped with oil pumps for flooding the tools with cutting oil, and may therefore be used at top cutting speeds.

SUPERVISION

In most shops where automatics are installed it is the custom to assign one man to these machines, whose duty is to see that they are properly set up, and in case there are only a few machines, to do the actual setting up and also to make a study of various contemplated jobs to ascertain if they can be made on these classes of machines to advantage. Such a man will soon find a number of jobs that may be made cheaper on the automatics than by other methods, resulting in reduced shop costs. This supervisor should make sketches of the first set-up of various jobs on the various machines. These will be of assistance for future jobs. Preferably a draftsman should make drawings of the set-ups, which will be valuable as shop records and also in the absence of the supervisor. This will work two ways. If the machines are not run up to the original speed some one is at fault. If the supervisor is ambitious he will soon find ways to turn out work quicker than the original set-up.

The nature of the work will govern the number of machines per man. Generally speaking, one operator is necessary for four machines.

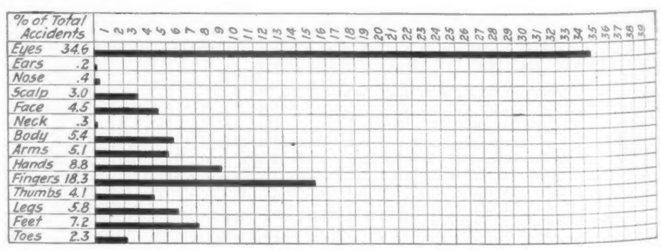
WHEN SHOULD AUTOMATICS BE INSTALLED?

There is not much to be gained by installing less than four automatics. This number would require one man to supervise and set up and one man to operate. The machines need not all be the same, but should be selected with reference to the work that is in sight. Under most conditions for railway work one multi-spindle machine for staybolt sleeves, having bar capacity of about $2\frac{1}{4}$ in., two single spindle machines of about $2\frac{1}{4}$-in. bar capacity and an automatic chucking machine will be found suitable. These will demonstrate the possibilities of this class of machine.

Considering these machines from an investment standpoint, they generally cost more than plain machines of equal capacity, such as lathes, turret lathes or hand screw machines. They will, however, turn out more work under average conditions when properly operated. Therefore, the money invested per unit output will not be much above other machines, and the labor costs will be found very much lower because of the fact that one operator attends to a number of machines.

AN INSTRUCTIVE CLASSIFICATION OF ACCIDENTS

The Pullman Car Works recently analyzed the accidents occurring in the company's shops during the year 1918 to determine the relative extent to which the various parts of the body were involved. The result of this analysis is shown



Anatomical Distribution of Accidents

in the chart below, which is taken from the Pullman Car Works Standard. It is interesting to note the large percentage of optical accidents, many of which were due solely to the carelessness of employees, as they could have been prevented by the wearing of goggles, which are furnished free of charge.

Who Are the Real "Live Wires?"

"J. W." Discovered One of Them Just in Time; Read the Story and Then Formulate Your Own Answer

BY A. J. TEN CATE

THINGS were not breaking right at Hadley. Everybody knew that from the office boy who shot craps in the filing room with Rastus Johnson, the colored janitor, to the president of the road 500 miles away, it was known that something was amiss, that something was radically wrong in the big shops at Hadley. Not that there was friction of any kind to mar the harmony of the organization; there was no factional strife—no pulling against one another, nor was there any lack of loyalty on the part of the organization to the shop superintendent, John Williams, commonly known among the men as J. W., whom the men all respected, and who in turn swore by his men.

True he swore at them as well. In fact he hadn't done much of anything else lately but express his feelings in profanity of the sulphuric sort, for to tell the truth, J. W. had seen matters go so rapidly from bad to worse during the past few months that he was beginning to feel that he had a "Jinx" of some kind hovering over his head that was destined to "get him" if things didn't change mighty soon at

Even the Office Boy, Who Shot Craps in the Filing Room with the Colored Janitor, Knew that Something was Amiss

Hadley. But deep down in his heart he had always believed in his "boys" as he called them—had faith in their ability and loyalty and, up to the time our story opens, he had felt that they would be able to overcome the difficulties looming up so formidably and soon have things going right.

With but few exceptions, the personnel was the same as it was six years before when J. W. took charge. He had come to Hadley at a particularly opportune time, succeeding a man who had been very unpopular with the organization and, having had a large experience in handling men he had shrewdly "cashed in" on his predecessor's unpopularity by showing an immediate disposition to treat the men fairly. By quickly gaining their confidence and good will, he had soon secured a spirit of co-operation heretofore unknown. Of course, this had a decidedly beneficial effect on shop output and better results than ever before were soon obtained at Hadley and J. W. was given the credit for being a genius in shop management, without having really effected a single change in the organization or methods. The output prior to his advent had been 12 to 14 engines a month, which soon increased to 16, a figure never before reached in those shops.

Naturally, the management was highly pleased at the showing and the superintendent of motive power never lost an opportunity of telling how they did things at Hadley.

The shops at Hadley had always taken care of the general repairs on all power operating on three principal divisions. This had been done satisfactorily for many years, but gradually, as traffic grew, and new and heavier power was made necessary, it became increasingly evident that Hadley shops were entirely inadequate to handle the repairs required to keep power in shape. In fact, scores of engines had been put in service that could not be gotten into the shop at all. For a while these engines were given only light repairs in the various round houses where they were assigned, but this of course, could not continue, and with a greater volume of business than ever confronting the road, the company had finally decided to enlarge Hadley shops to suitable size and capacity for the overhauling of 30 engines per month. The work had been started a year and a half before the commencement of our story.

BUILD NEW SHOPS AT HADLEY

Unlike many roads where large shops are reconstructed, there had been no controversy of any kind over proposed design or construction. When it had finally been decided to make the improvements, "Get together" meetings were held, often in the president's office and everybody who had an idea was given an opportunity to express it. When the final plans had been approved it was found that the cost would approximate a million dollars, but this was not considered too great an expenditure for the results expected.

When it came to shop equipment, machine tools and appliances, the management had used a lavish hand, installing many of the new and expensive tools which, to J. W., seemed unnecessary and ill advised. In his estimation, the majority of the later types, which were unknown in his day, were only useful on special work, and he would much rather have had more lathes, planers and boring mills than the grinders, millers of various types and other machines which were not familiar to him. He seriously doubted their ability to make good on general utility work.

When the shops were completed and everything in readiness for operation, it was conceded by those who were in a position to compare them with other shops of similar capacity, that the new shops were far superior in many ways and capable of greater output than many shops of a more pretentious character employing a greater number of men.

"J. W." COULDN'T GET 30 ENGINES A MONTH

The first month or two after completion nothing was said to J. W. about output. That it would take some little time to get organized on the new basis was to be expected, and as he enjoyed the confidence of the management to an exceptional degree, nothing was said when at the end of two months the output had only been increased to 19 engines per month. But now after six months, and with 20 engines, the largest number overhauled so far for one month since the shops had been completed, the management had begun to take serious notice of the unfortunate situation. At first, only inquiries of the most friendly character had been made. These failing

to bring satisfactory explanation for past failures, and to convey information as to when an improvement could be expected, soon became demands for explanations.

The situation was greatly aggravated by the division superintendents, who were constantly wiring the general superintendent about congestion in their respective territories due to shortage of power on account of inability to get engines through Hadley shops. The president, who had been extremely lenient the first few months, was now aroused over the situation and demanded results without delay.

Of course the superintendent of motive power was after J. W. and J. W. was after everybody at Hadley.

A mechanic of the old school and still clinging to many old fashioned ideas, he made no effort to solve the problem by applying new methods. In fact it was known that J. W. had but little time for some of the new fangled notions advocated in other shops. He had held staff meeting after staff meeting during this period and given everybody a chance to make suggestions for improvement. But no one came forward with anything tangible in the way of a solution. None of them had ever been employed in a supervising capacity elsewhere and only knew one way to handle their work, and that way was not getting results now.

At these meetings it was invariably brought out that the machine shop was inadequate to turn out the finished parts for an output of thirty engines per month. To do the machine work for this number of engines, and at the same time fill the many shop orders to keep six round houses supplied with finished material ready to use, was altogether too much for the machines they had. Fred Shipley, the machine shop foreman, whose ability was unquestioned, said it could not be done. George Wheeler, the general forman, was equally sure that Fred was right.

The erecting foreman agreed to put the work up and get the 30 engines, if he could only get the finished parts as fast as he called for them. J. W. got acrimonious as time went on and the demand of the management for output became more insistent.

"Somebody Has Got to Do Some Heavy Batting"

One day he received a message from the president to meet him at the station on arrival of Number Seven. He was under no illusions whatever as to the character of his forthcoming interview with the big boss, and as he climbed on board the president's car that afternoon, and noted the expression on the face of the president who had always before had a smile of welcome for him, what little hope he had failed him. He realized that something *would* have to be done if he remained at Hadley in his present position.

"Mr. Williams," said the president, when J. W. was seated, "if I had lost that million the company gave me for improvements here in a good clean cut, fast game of poker, I would not have felt so bad about it as I do under the present circumstances. As the game now stands"—the president was an old baseball fan—"the company has put up their good money for a fluke—not a hit made so far. I wanted to say to you first hand, so there wouldn't be any misunderstanding about the matter, *somebody in Hadley has got to do some heavy batting from now on.*"

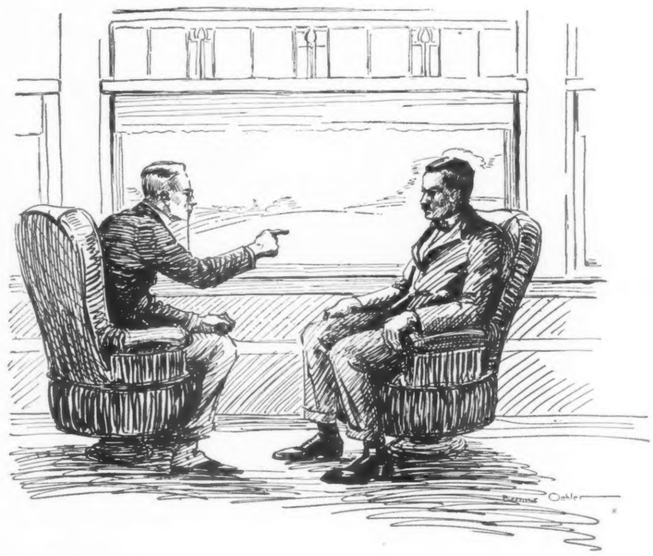
When he got back to the office, J. W. sat down and thought the matter over. It was plainly apparent that he was getting all he could out of his organization under present methods. While he seriously questioned if the results expected by the management could ever be obtained, he began for the first time to consider a change in foremen.

As this idea became fixed in his mind, he left his office and started down through the shop. At every machine he passed he noticed the inevitable pile of work waiting its turn to be finished, all marked "rush." He noted that every operator was pushing his machine, both feed and speed.

"I doubt if it can be done," he said to himself as he reached the lower end of the shop. As he turned round he was attracted to a big boring mill over at his right which was being operated by a tall, broad shouldered young man of perhaps 25 years of age. J. W. instantly noticed piles of finished cylinder packing rings close at hand, and a little further away some pistons which were completed. It was the only machine he had seen so far that did not have a lot of unfinished work piled all around. He remembered too, that this was always the case with Tom Wilson's machine, and he wondered why he had never looked into it before.

"J. W." Hears the Truth

With this thought in mind he walked over near the machine and watched its operation awhile. Suddenly it struck



"If I had lost that million the company gave me for improvements here, in a good, fast game of poker, I would not have felt so bad about it as I do now."

him that for a boring mill, running as that one was, it was unusually silent. Most mills he had ever run were about the noisiest machines in the shop, especially when going at the rate this one was running. The next thing that attracted his attention was a tool the operator was using that was doing business very effectively. J. W. was interested.

"Tom," he finally said, "you certainly have the edge on the rest of the gang when it comes to turning out work. You're the only man in the shop who is not snowed under; how do you account for it? "Why, I guess there ain't any secret about it, Mr. Williams," replied Tom, as he looked around with a smile, "I simply try to use my head and spare my heels; anybody can do the same if they try."

"Some tool you have there, Tom," went on J. W. eyeing it, "where did you get hold of that? I never saw one like it before."

"Why, I got the idea from something I read, got the blacksmith foreman to make it for me and you see the result; she sure does the business;" replied Tom proudly. "Saves tool steel too," he went on, "don't use half so much as I used to since I got hold of this tool."

"How do you keep that mill so quiet?" J. W. asked, as he again noticed how still the boring mill was running.

Tom laughed. "Well sir, I thought you'd notice it after awhile. I just experimented on a little compound of my own. I read awhile ago of something that was done like that somewhere else and I just thought if I could produce a little silence instead of listening to the constant noise this machine always made, it would be a welcome change, so I

went at it and you see what it does. I only use it twice a week; costs less than the old way of oiling and the comfort I have had since I began to use it can hardly be described.

Tom's replies set J. W. to thinking. He knew Tom Wilson was an energetic, observing fellow. He knew too, that he had never heard a complaint from any one about pistons or cylinder packing since Tom had been put on the job, and before that, it was nothing but complaints. Tom's evident resourcefulness prompted J. W. to sound him a little on the subject nearest his heart.

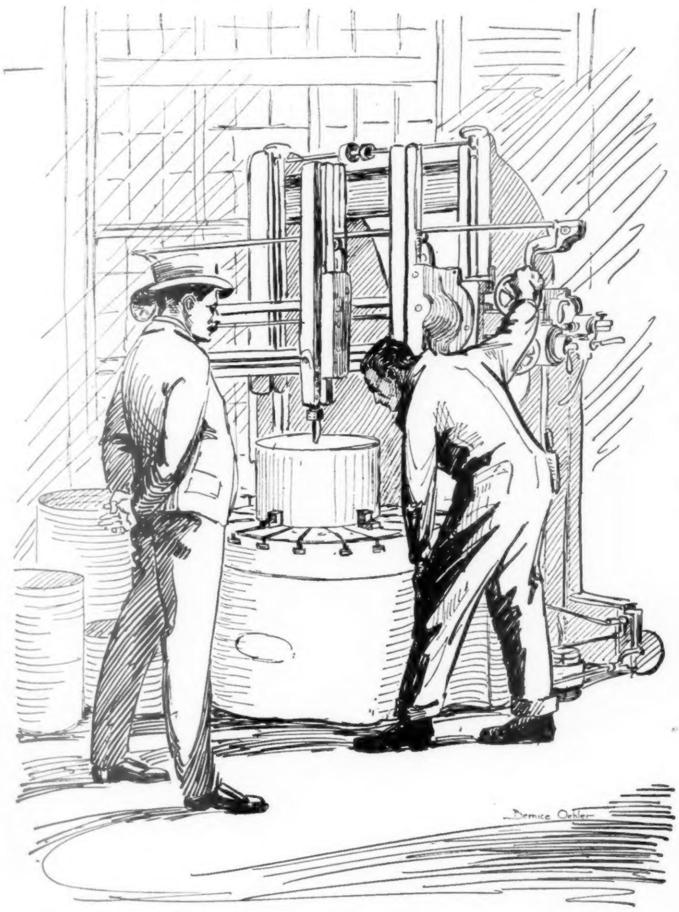
"I wish I could get the same results from other machines that I get from yours, Tom," he said. "You know we are trying to get 30 engines a month; what do you think of it?"

"Well sir," replied Tom, "I can't see why we shouldn't."

"You can't!" gasped J. W., scarcely believing he had heard Tom correctly.

"No sir," asserted Tom, "I can't see why."

"You're crazy," said J. W. when he had regained his speech. "Do you see anybody idle up through there?" point-



J. W. Walked Over Near the Machine and Watched Its Operation

ing at the long lines of machines and their operators, all hard at work.

Tom merely glanced in the direction indicated and said quietly, "It is not a question of anyone being idle, Mr. Williams, it is only a matter of method."

"What do you mean by that?" demanded J. W., his gorge rising at the cock-sure manner of treating a matter which had caused him more sleepless nights than anything else he could remember ever having been up against. "Do you know any better methods?"

He never did relish criticism and when it came from a man like this, only out of his time about three years—well, it didn't listen good.

"I know this," said Tom, noting his chief's rising anger, "there are many machines in this shop not operating half the time, that are considered big producers in other shops. Those grinding machines, for instance, only do certain work here, while in other shops where they've got them, they work night and day on work never attempted on them here.

"They are grinding driving and trailer axles, engine truck journals and packing rings in many shops now-a-days, and doing it quicker, more accurate and with a better finish than by the old way. There are other machines here too," went on Tom, "that are handled to better advantage elsewhere, which could help relieve the congestion here."

In spite of his anger, J. W. felt he was hearing something worth while from a man he knew to be no fool. Determined to get all he could out of Tom, he went on.

"How do you happen to know so much about what they do elsewhere, that's what I would like to know?"

"Well, sir," replied Tom, "for one thing I read. I like to keep posted on my line of business. You probably see more of the mechanical papers than I do."

"Oh yes," replied J. W., "I see enough of them, but you don't suppose I spend my time reading all the stuff they print, do you? Theory is one thing, my boy—practice is another." J. W. prided himself on being practical.

"But they are not all theory, Mr. Williams," said Tom. "For instance, a few months back I read an article on how they did their driving boxes at Sawyer on the R. L. & N. Jack Raymond is working in Sawyer. You remember Jack—worked here while I was serving my time. Well, I wrote and asked him if they were actually doing it the way the article said? He replied that they sure was."

J. W. was silent. He felt he had heard the truth, but it had come in painful doses for ready assimilation. He turned without a word and started away.

Suddenly he wheeled around to Tom again and said, "Why the devil didn't you speak to Shipley about all of this long ago?"

Tom tried to evade the question but J. W., his suspicions now aroused, insisted on a reply.

"Why, I did a couple of times, Mr. Williams," he said, "but he didn't take very kindly to it."

"What did he say?" demanded J. W. "I want to know."

"He told me I was hired to run a boring mill, that he could do all the theorizing that was necessary around here."

"He did, eh?" said the irate shop superintendent, now fully understanding Shipley's attitude at a time when he ought to have welcomed a suggestion from anybody interested enough to make one. "You shut down your machine and come to the office with me."

A NEW MACHINE SHOP FOREMAN AT HADLEY

On the way J. W. met the call boy and sent him for the general foreman and Shipley, who soon appeared at the office.

"Gentlemen," began J. W. as they were all seated, "it has come to a point where things have got to be done different around here. We've got to get out more machine work if we increase our output to thirty engines. What are you going to do about it, Shipley?"

"I have done my best," replied Fred, "and I am ready to take my hat off to the man who can get out any more work than I have already done. I can't get blood out of a stone and neither can anyone else, but I'd much rather go back on a machine and let someone else have the job for awhile, than to stand the gaff for not being able to meet somebody's unreasonable expectations; I've had all of that I want."

"Well, Fred," said J. W. after a pause, "I am going to take you at your word. Take any machine you want in the shop, and Mr. Wilson here," looking at Tom, "will take your place tomorrow morning. What do you say, Tom?"

"I'll do the best I can, Mr. Williams," said Tom, "but I

would like to have you make it clear to these gentlemen that this is entirely unsolicited on my part, and something I never dreamed of."

"What he says is exactly right," said J. W., turning to Shipley and the general foreman, "I never thought of this change myself up to twenty minutes ago. I want it understood that Tom had no knowledge of this move or reason to believe he would ever be considered for the place. Further, if he don't make good he will come off the job just as suddenly as he goes on," and with this parting comment the meeting closed.

The next morning Tom took charge. The first thing he did was to get some men on the machines not regularly run, with instructions to clean them up, inspect and oil them ready for business. He then began a thorough check on work most needed by the erecting side and gave this immediate attention. Inside of a week he had re-distributed the work that was piled around the machines with the result, that in an incredibly short time machine production of required work began to increase. The grinders were kept going constantly on work formerly done on lathes, and the milling machines began to make a little money for the company, as Tom put it. In short, every machine was allotted only the work best suited to it, and each was worked to capacity.

THE SHOE BEGINS TO PINCH THE OTHER FOOT

Along with the new order of things there came a better spirit of co-operation on the machine side. Long blamed for holding up output, constantly rushed from one job to another, weeks of work always ahead of them, and never permitted a day off, no matter how hard they worked—many of the men had long since lost interest in their work and some of them had sought more congenial conditions elsewhere. After Tom Wilson had been in charge but a few days all that was changed. The big piles of waiting work had somehow disappeared. The men soon noticed too, that they were not being nagged by erecting foremen after this or that piece of work. Those gentlemen, formerly on the machine side half the time finding fault about delayed parts, suddenly seemed to have more business on the erecting side to engross their attention. The erecting gangs were having all they could do to put up the work Tom was sending over to them.

J. W. was not slow to notice the welcome change. The way he went after those foremen and the general foreman "was good for sore eyes," as old Sam Mason said. Sam, one of Tom's lathe hands, had overheard some scorching comments J. W. had made to the general foreman about "the shoe pinching the other foot now."

Tom kept after the machine work and his men were with him, for they liked the results of his new methods. They hugely enjoyed the turn affairs had taken; it was a satisfaction to see some one else the goat.

In the meantime it had become apparent that, while output for the month would reach 25 engines, the erecting side could handle no more than that. Much of the machine work for other engines laying in the shop had been done but no effort had been made to start putting it up.

"Tom," said J. W. one day, "we've got 'em going; we are going to get 25 this month. I only wish I could get another one or two."

"Why I guess we can do it, Mr. Williams," said Tom after thinking a moment.

"How can we do it, Tom?" demanded J. W.

"Why I am way ahead of the game and happen just now to have a man who says he is an old erecting foreman and I can spare him for awhile. He told me this morning that he would like to show them how to put one together, and I could give him another good man, a couple of apprentices and some helpers. I'll gamble they would get a couple more; the work is all ready for hanging, you know."

"All right," said J. W., "get those fellows lined up and see whether you can get the engines out."

That afternoon the new gang went to work. Whenever Tom could send them any more help he did it and two more locomotives were added to the month's output. The general foreman was not at all pleased with this arrangement and frequently let Tom know it.

When the end of the month arrived 27 engines had been overhauled. J. W. was jubilant. He openly gave Tom credit for all that had been accomplished and this was more than the general foreman could stand. He went to J. W. and requested a leave of absence, he was "all in" he said and needed a rest.

TOM'S METHODS GET RESULTS

J. W. told him to take as long a vacation as he wanted, secretly delighted at the turn events had taken, for he knew

"I Like to Keep Posted on My Line of Business"

Tom could do better with the general foreman's influence out of the shop. He gave Tom full charge temporarily.

Tom's first official act was to mark up 30 engines for the next month's output. His next was to divide up the erecting gangs so that more engines were covered at one time. With the general foreman gone, Tom had no difficulty in securing the best of support from everybody. By the middle of the month it was clear the 30 engines would come easy and the entire organization was as proud of the showing as J. W., who was beginning to enjoy life again.

One day toward the end of that month he sent for Tom and showed him a letter of resignation he had just received from the general foreman, who had secured another position.

"Tom," said J. W. after he had read the letter, "I'm going to appoint you to the position. The superintendent of motive power is mighty well pleased with what we are doing here now, and I want to see the same results continue."

"Thanks, Mr. Williams," Tom said, "I'll do my best."

A day or two later J. W. was down at the depot just as Number Seven pulled out. As he glanced down the long train he noticed the private car of the president on the end.

"Wonder what he thinks of our batting average now?" he mused.

With his eye following the rapidly moving car, he paused at the end of the station platform. As the car was passing him, the president, who was seated at a window, saw J. W. and started for the door.

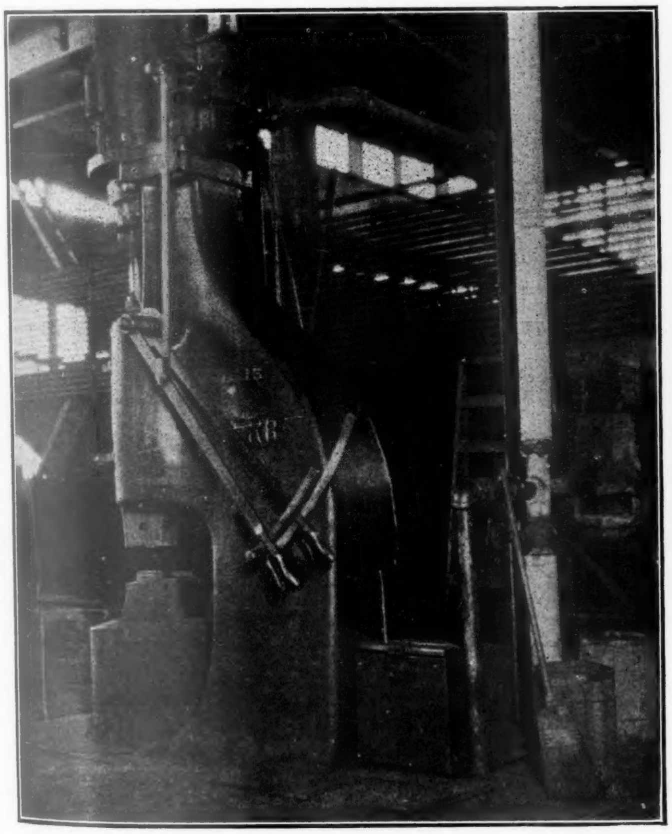
From the rear platform he called out "How's the game?"

Putting his hands to his mouth, megaphone fashion, J. W. roared back, *"Everybody batting over 300."*

NEW YORK CENTRAL STEEL CAR SHOP

Well-Equipped Plant at Ashtabula, Which Employs Some Unusual Methods of Forming Parts

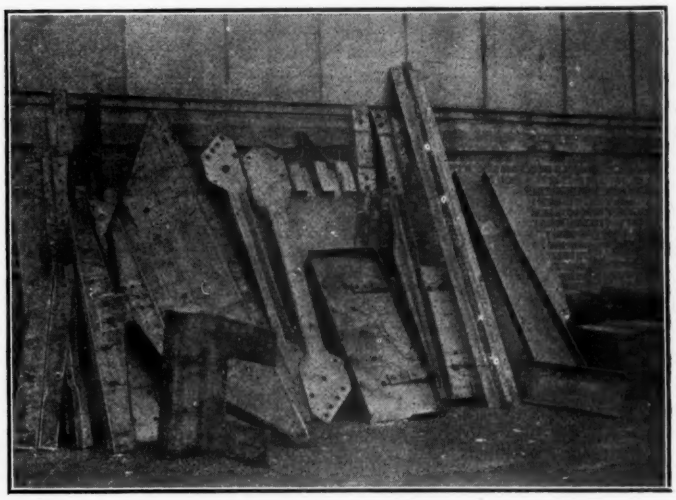
THE INCREASE in the amount of steel car work at Ashtabula, Ohio, several years ago overtaxed the capacity of the existing facilities. To take care of this class of work a special shop was erected in 1914 on a site about one mile west of the old shops. This building is of brick, concrete and steel construction, 431 ft. 3 in. long and 243 ft. 6 in. wide. It is divided into three bays of approximately equal width. The roof has six square double monitors, 10 ft. high extending across the building, the extreme height at the gables being 51 ft. and at the sides 42 ft. Each of the two side bays has four tracks with a capacity of eight cars each, on which the repair work is done, and two standard gage material tracks. The repair tracks are spaced 18 ft. apart, except where the supply tracks run between them, in which case the distance is increased to 22 ft.



Steam Hammer Operated by Either Steam or Air

The center bay is used for straightening, fabricating and machining, all the machine tools being located in this section. A supply track extends along the east side of this bay for its entire length and a short stub track runs in at the north end. East of the main shop building are the office, store room, power house and transformer building and the air brake building.

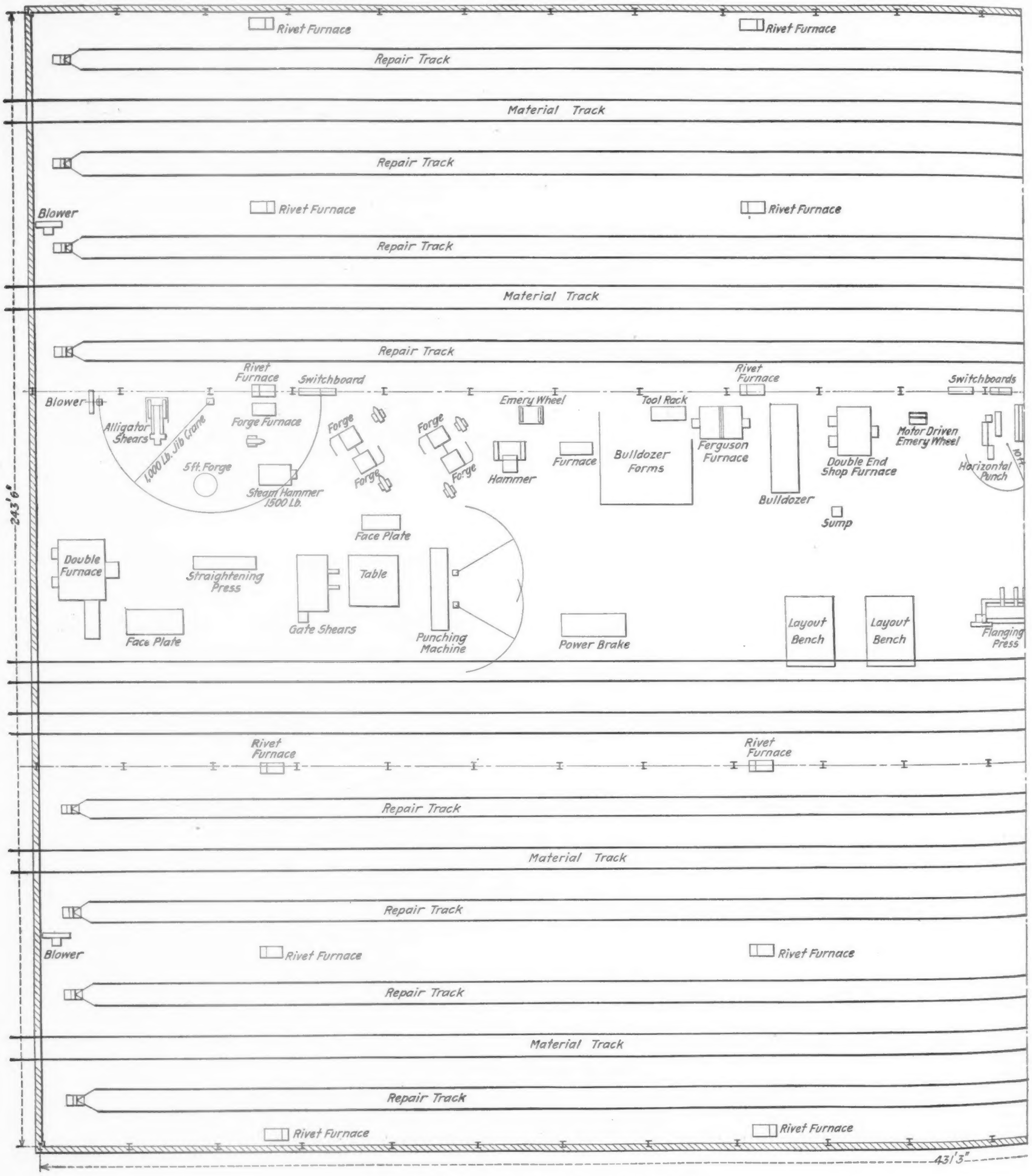
Power for the shops is secured from a high tension power line at 13,000 volts and is transformed to 440 volts for power and 110 volts for lighting. The shops are heated from a battery of three locomotive boilers, two of 150-hp. and one of 100-hp. capacity. A vacuum return system is used, the radiating pipes being placed directly on the walls and columns. The compressed air is furnished by two Ingersoll-Rand electrically driven compressors, each having a capacity of 1,500 cu. ft. per minute. Air lines are installed along both sides and also between the center tracks in each working bay. Fuel oil is piped from the storage tanks, located adjacent to the store-house, to the plate furnaces in the center bay and to the stationary rivet furnaces located in the side bays. All the furnaces are also supplied with natural gas, which can be used in case of a shortage of fuel oil. Air for the blast is furnished by electrically driven blowers, one located in



Parts Formed on the Bulldozer

each bay. The lighting system consists of incandescent lamps in enameled steel reflectors set along the bottom of the roof trusses with connection for extension cords along the walls.

The main shop building has traveling cranes covering the entire floor area of all three bays. The cranes are of 20 tons capacity and run on rails 24 ft. above the floor. Further facilities for transporting material are furnished by the supply tracks which run between the repair tracks and extend on to the material platform at the south end of the shop.



South Half of the Ashtabula Steel Car Shop

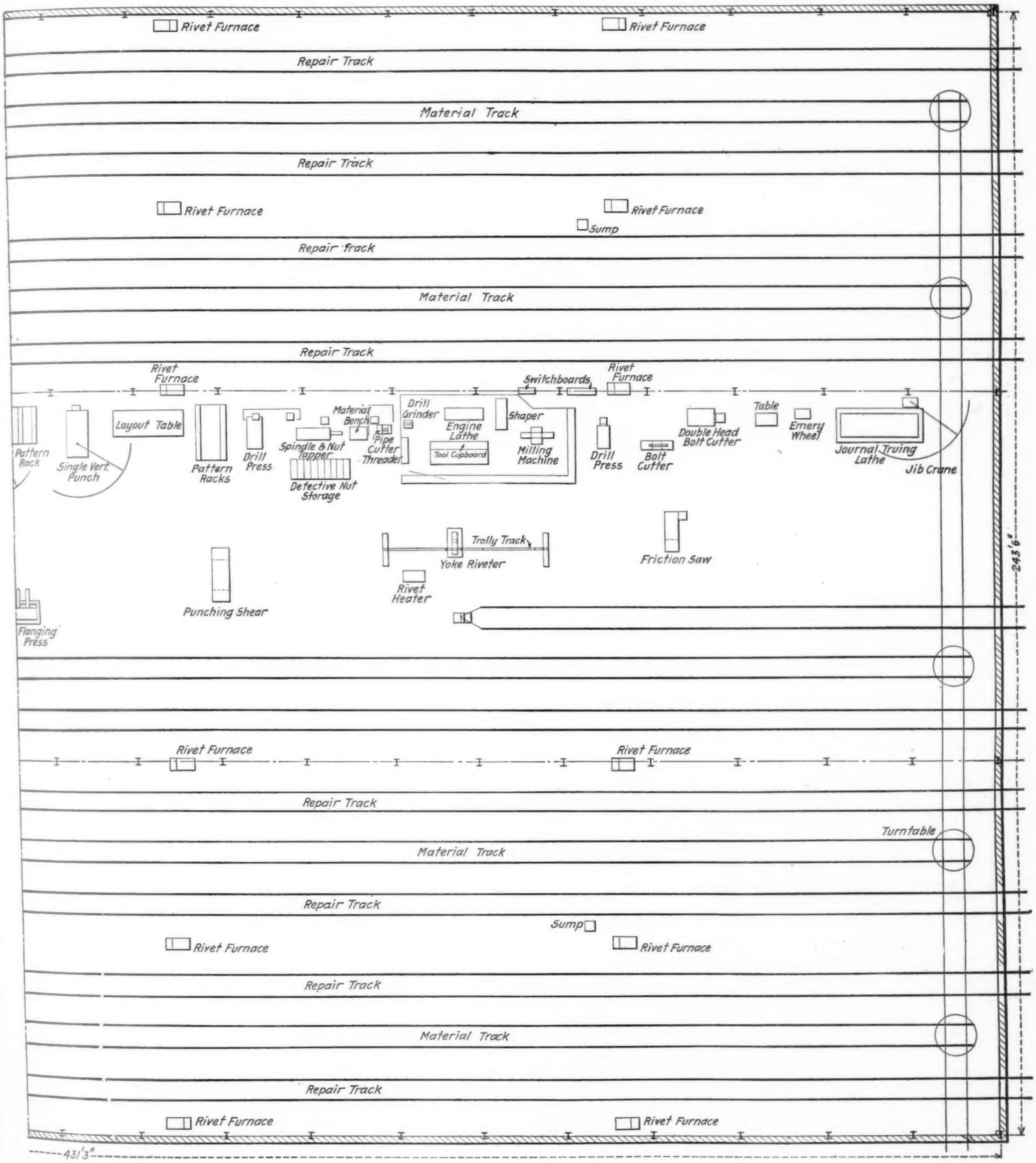
There are two traverse tracks crossing all the supply tracks, one on the material platform, and the other just inside the north end of the shop. Turntables are provided at the intersections of the tracks.

The track layout is such that cars enter and leave the repair tracks from the north end of the shop only. When the cars are set in the shop they are lifted by the crane while the trucks are removed and horses set under the body. The trucks ordinarily remain on the track at the end of the car while it is being overhauled, except that when wheels are

to be changed or other similar work is to be done, the trucks are often set in the supply track. The forces working on dismantling and assembling are divided into gangs of six men each, three usually working on each end of a car.

The majority of the work of straightening sheet metal out being removed. Next in order along the center bay is the blacksmith department, which has five forges and anvils and two power hammers.

The heavier work in the blacksmith shop is handled on a 1,500-lb. Erie steam hammer, while for lighter operations a



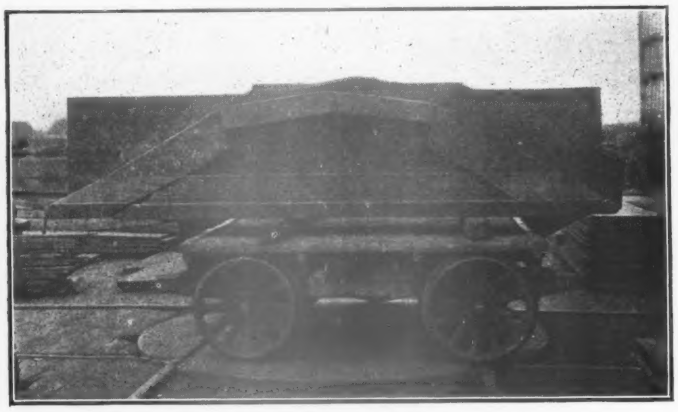
North Half of the Ashtabula Steel Car Shop

parts is handled at the extreme south end of the shop, where there is a double furnace 10 ft. by 12 ft. 8 in. Adjacent to this is a large face plate and a pneumatic straightening press. A large jacking stall is now being erected outside the shop to care for cars on which the parts can be straightened with-

Bradley impact hammer is provided. A notable feature in connection with the steam hammer is the fact that it has both steam and air connections. This hammer is the only steam driven tool in the plant and it would have been necessary to keep one boiler in service at all times in order to operate it,

had it not been possible to use air pressure in the summer.

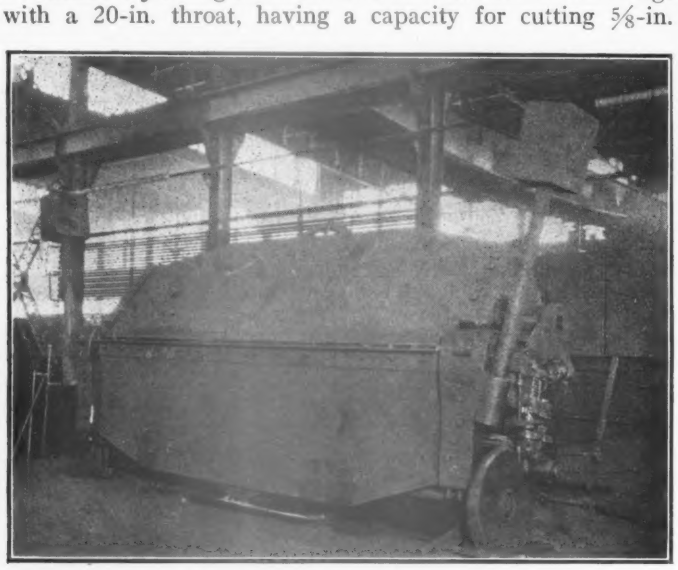
A large amount of the forming work done at this shop is pressed out in a No. 8 Ajax bulldozer driven by a 20-hp. motor. Dies have been made at this shop for many of the standard sheets used in all types of steel cars owned by the New York Central Lines. These dies are of unusual construction, being built up of plates and bars riveted to the plates which form the base. While this type of die was adopted largely because it could be more readily made with the facilities available, it has numerous advantages over cast iron dies. It can be made without a pattern, it will not break and errors in machining can usually be corrected at slight expense by changing a few parts. Two of the illustrations show a typical pair of dies, together with the part which is



Built Up Dies Used on the Bulldozer

formed on them. Another illustration shows the wide range of work that is handled on the bulldozer. The parts include hopper side sheets, hopper doors, side stakes, carrier irons, striking plates and end sill corner braces. The bulldozer is also used for the class of work generally performed on these machines, such as forming coupler yokes, etc.

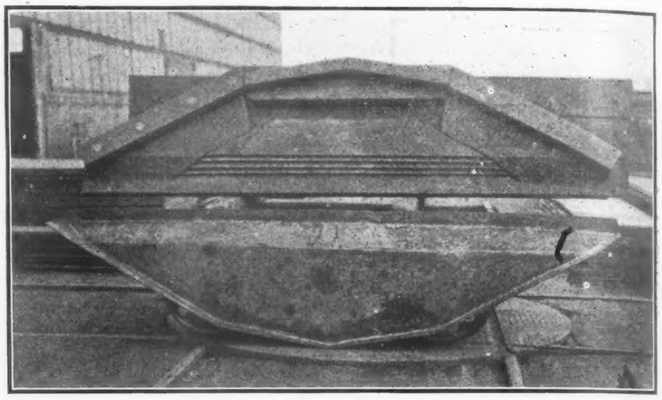
Alongside the blacksmith department are located some of the machines for the cold working of plates. These include a Hilles & Jones gate shear 124 in. between the housings with a 20-in. throat, having a capacity for cutting 5/8-in.



Power Brake With Capacity for Bending Half-Inch Plates, Twelve Feet Long

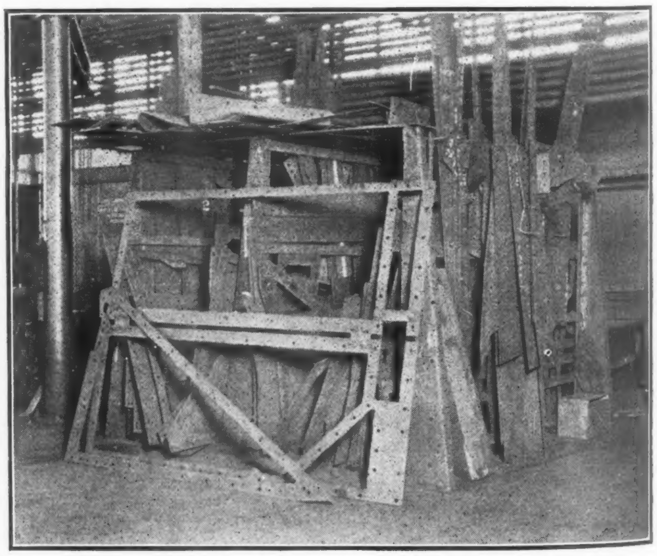
material, and a Cleveland vertical, double ended punch and shear with a 48-in. throat. Cold flanging is handled on a Chicago power brake with a 12-ft. by 6-ft. table. This machine is driven by a 25-hp. motor and will bend a 1/2-in. plate 12 ft. 1 in. long. When working on parts made in quantities it can be set to bend any desired angle, which will be automatically duplicated until the machine is reset. For other flanging work there is a 200-ton hydraulic press built in the railroad company's shops.

Two large layout benches are provided near the flanging



Built Up Bulldozer Dies and Hopper Side Sheet Formed by Them

press. The laying out on the majority of plates for system cars is done with templets made of sheet metal. Wooden templets are often used on work of this nature because of the ease with which they can be made. The use of wooden templets was not considered advisable at this shop because of the excessive amount of space required for the storage of a large number of templets and also on account of the possibility of inaccuracies due to warping and shrinking. The metal templets are cut away wherever possible in order to decrease the weight. In this form they are easy to handle and experience indicates that, due to their longer life, they are



Sheet Metal Templets for Laying Out Parts of Steel Cars

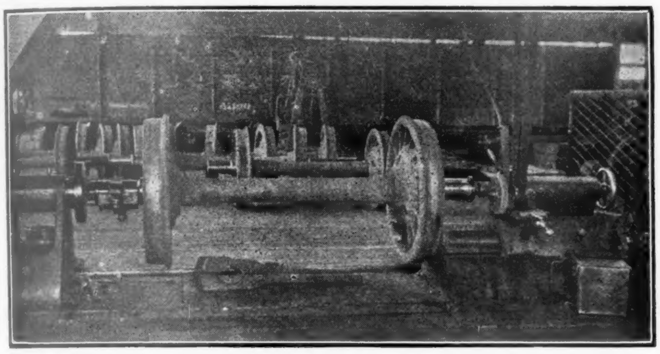
more economical than templets made of wood, even though the first cost is higher.

For punching partly or wholly completed sheets a horizontal and a vertical punch are provided near the center of the shop. Large plates and angles are handled on an Oeking combination punch and shear, which will split plates of any length and width and will shear angles up to 3/4 in. by 6 in. by 6 in. and bars up to 2 1/8 in. square. Large structural steel shapes are cut on a Ryerson No. 2 friction saw with a capacity for cutting 15-in. I-beams, up to 60 lb. per ft.

Parts which can be assembled before erection are handled with a Hanna pneumatic riveter especially arranged for this work. The machine which has a 20-in. gap and a 24-in.

throat is mounted upright on a stake. A chain hoist runs on a trolley track directly above the riveter so that parts after being assembled can be slung from the hoist to facilitate the riveting operation.

The tool room is located in the north end of the shop. It provides a supply of pneumatic and hand tools and makes the special appliances used around the shops. The machine tool equipment consists of a 24-in. heavy duty shaper, a Lodge & Shipley 8-in. engine lathe and a Kearney & Trecker No. 2-B Universal milling machine. Beside the tool is located equipment for reclaiming miscellaneous small material. The small scrap collected around the shop amounts to about 20 tons a month. From this material the bolts that



Machine Used for Truing Journals by Grinding

are fit for rethreading and nuts that can be retapped are sorted out and returned to the shop where they are reclaimed and again placed in stock.

The truing of cut journals is handled at this shop on a special machine built in the railroad company's shops, on which the journals are ground instead of turned. The illustration shows the general arrangement of this machine. The wheels and axles are swung on centers and are driven by a dog attached to one journal. At the other end of the machine there is a tool post which carries a grinding wheel driven by a belt from an overhead countershaft. The wheel can be traversed back and forth along the journal until it is ground truly cylindrical. Because of the fact that no water is used while grinding the journal is polished by the use of emery paper. This device makes it possible to true journals with the minimum reduction in diameter. It is being installed at all the principal car repair shops on the New York Central Lines.

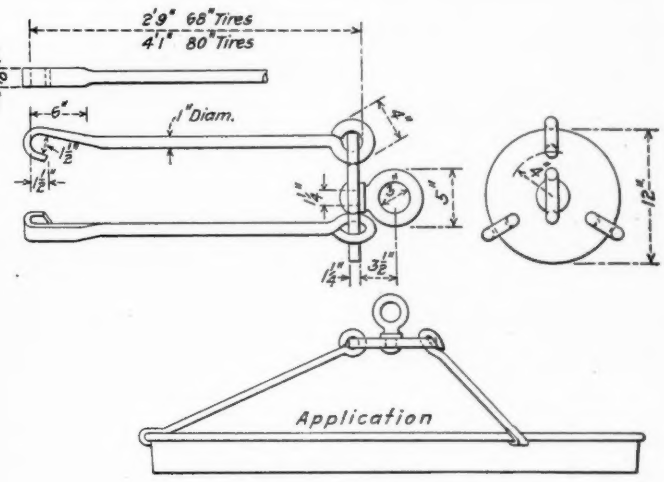
TIRE LIFTING DEVICES

BY E. A. M.

Crane attachments for lifting plain and flanged locomotive tires as illustrated in the drawings have proved very useful.

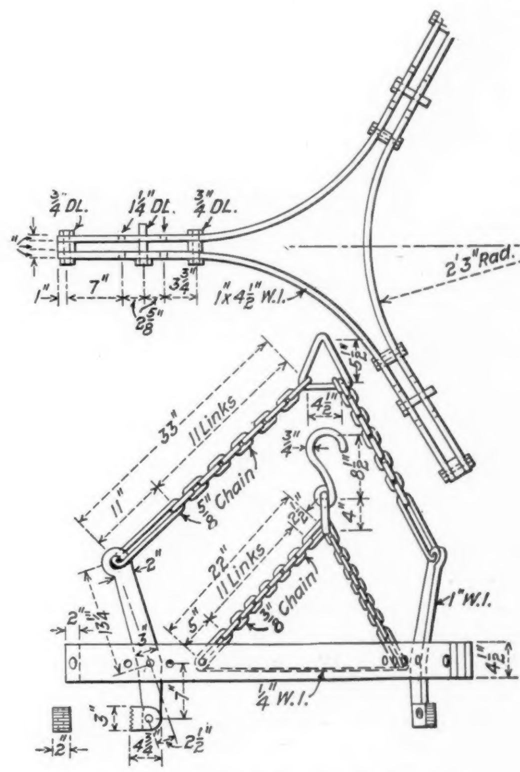
The device for lifting plain tires is made of three pieces of 1-in. by 4½-in. wrought iron bar bent to a radius of 2 ft. 3-in. and bolted together by ¾-in. bolts, as shown in the drawing, with a spacing block between the bars to provide space for a lever near each of the three ends. These levers are of 1-in. wrought iron, three inches wide at the center, where the pin is inserted, and two inches wide at the ends. On the lower end of each level a steel jaw with teeth cut in it engages the tire while lifting it, the weight of the tire tending to tighten the grip of the jaws. On the upper end of each lever is a link and a ⅝-in. chain connecting the levers to a triangular link in which the crane hook is inserted. Three holes in each arm of the device, where the levers can be placed and the pins inserted, provide a means of adjustment to accommodate tires of different diameters. The small ⅜-in. chain is only for the purpose of carrying the device from place to place as it may be needed, the ⅝-in. chain being used for lifting.

The other device for lifting flanged tires consists of a plate 1¼ in. thick and 12 in. in diameter with three 1 1/16-



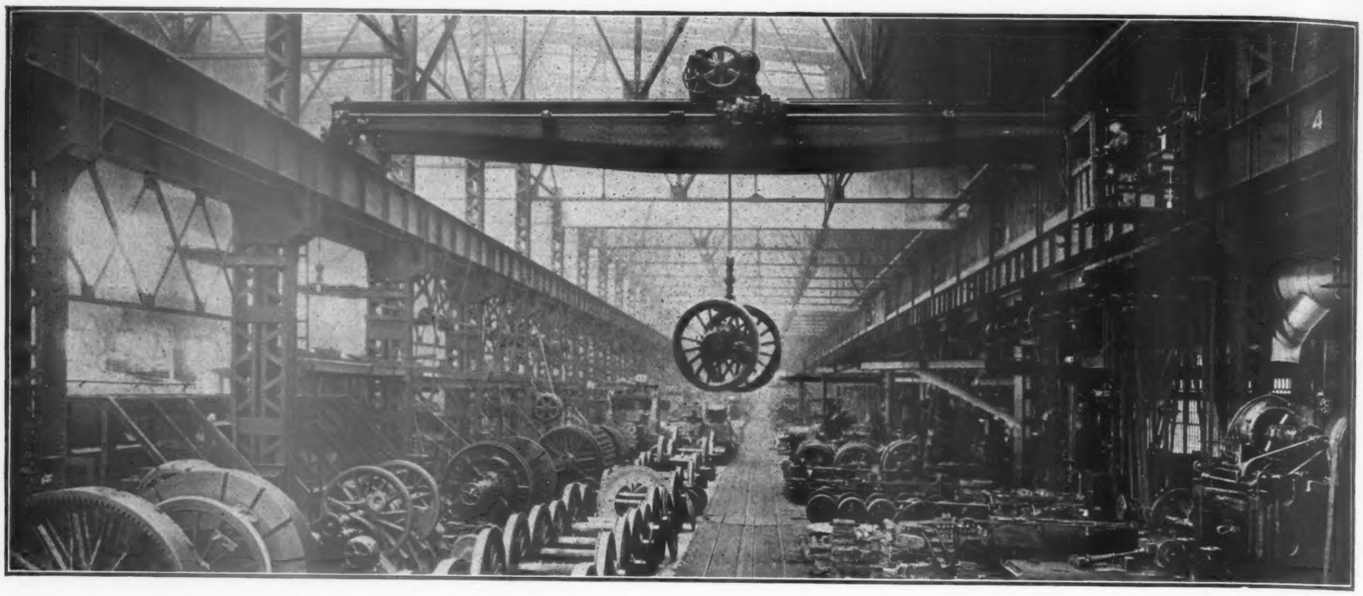
Lifting Device for Flanged Tires

in. holes drilled in a 8-in. circle and a 1-in. diameter rod with a hook on the lower end placed through each of the three holes with the eye bent over as shown in the drawing. An eyebolt of 1-in. round material is inserted through a hole in the center of the plate and riveted over on the under side, thus providing an attachment to the crane hook. The



Lifting Device for Plain Tires

three rods which engage the flange of the tire may be made in any desired length to accommodate a number of different sizes. By making the various parts to a close and accurate fit the hooks cannot slide and provide a safe method of handling locomotive tires.



C. P. R. Machine Shop, Angus (Montreal).

C. P. R. Shop Production Methods

Schedule and Follow-Up System which Is Part of, Not Separate From, the Producing Organization

BY E. T. SPIDY

Production Engineer, Canadian Pacific, Montreal, Quebec

PRODUCTION methods are the ways and means by which we get output whether it be locomotive repairs or new locomotives, coach repairs or new coaches, freight cars or anything else that constitutes a manufactured product.

Two methods which have generally been used with more or less success, according to the manner in which they have been employed, may be enumerated as controlling factors in getting a satisfactory output. The first and oldest is to have a piecework or other system that provides an incentive to the operator by making his earnings dependent on the amount of work done. The second, which may be said to be of later origin, is to lay out for each plant, shop, department and, if necessary, each workman, its day's work and to make possible the accomplishment of the task assigned by routing the work, tooling the shop machinery and taking measures to overcome all the factors that militate against the desired end.

The developments of the last few months with regard to piecework have created in most railway shops a condition which throws the onus of production entirely upon the management. If the managements do not have any other means or aid to maintain output than the regular supervision, then undoubtedly they are going to be hard put to it to maintain anything like their previous records.

Leaving the dead alone, however, the writer will confine himself in this article to the second class of aids to production, i. e., the setting of the day's work for each department and the means whereby each item may be followed up and completed on time, at the same time not interfering with the foreman's authority in each section.

The fact that the foreman's authority need not be interfered with is mentioned purposely. There are shop managers who will say that "we found it impracticable to run a schedule and have thrown it out long ago." No doubt this has been done and the reason is obvious enough when looked for. With these shops, the writer will willingly agree that it is impracticable to put into the hands of a set of clerks the running of an absolute schedule and to expect them to get results. *It is absolutely impracticable to get any results from any system unless all the foremen are convinced that the principle behind it is right and that they themselves, each in his own department, are the men who are running it and backing it.*

This all may be summarized by saying that co-operative

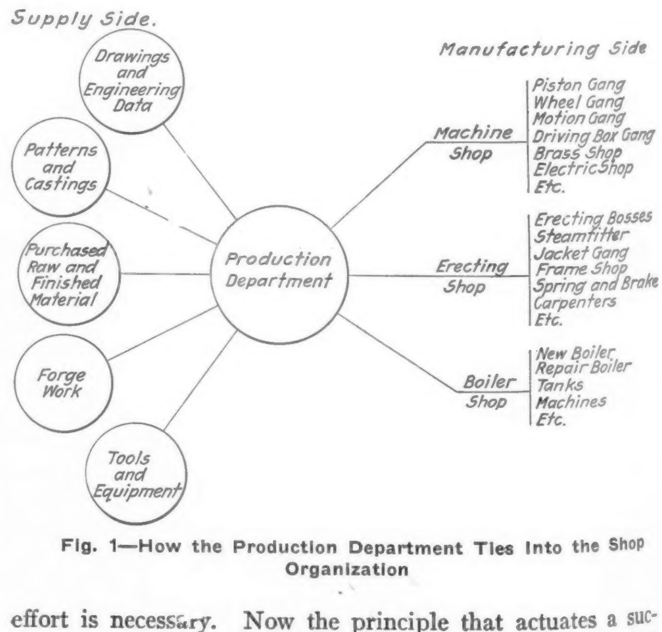


Fig. 1—How the Production Department Ties Into the Shop Organization

effort is necessary. Now the principle that actuates a successful production, planning or schedule department is just this: The production department is simply a specialized group of men who, at the direction of the management, spread over the month at as regular intervals as practicable

the output as required by road conditions so that each departmental foreman receives each week or day one sheet which tells him exactly *what* he is required to deliver finished and *when* the delivery is required. It is obvious that such a group under proper direction must have more information regarding delivery of materials from the supply sources, more information as to whether drawings are available, as to patterns, as to delays in other shops, etc., than any one foreman possibly can have, and that it can advise the management intelligently regarding the causes of delays far better than the individual boss who is only in touch with his own immediate situation. Shown diagrammatically, the plant with a production department operates as shown in Fig. 1.

There may be 40 departments, all of which require information from the supply side of the diagram. Without a production department how is this information secured? We all know what happens. Each foreman or sub-foreman or workman simply hikes to the other department and gets whatever information he can, personally. When he gets it, he tells the boss and the boss most likely verifies it in some other way and then does something.

Comparing this with the production department method, what do we find? The production department knows what is wanted by each department and has a date when raw material should be in stock by the stores. They check this, in many cases weeks before the material is due in the shops and consequently are able to report to the management future delays they see that look to be unavoidable unless immediate action is taken. In other words, they report delays in time for them to be prevented, or when they cannot be prevented, in time for a change in program to be effected without loss of output.

It is not to be presumed that delays do not occur under this arrangement, but they certainly are very much reduced. The very nature of engine repairs is such that much information is not available just when it is needed, especially regarding defects which are revealed after stripping down. Such situations must be handled as they come.

The principle having been outlined, a word is necessary to show how the production department is synchronized as a living part of the organization and not an outside unit, as the diagram makes it look.

The man who sets the master schedule, who designates the actual engine numbers of all engines that are to constitute the shop output, must be the general shop foreman. In practice the superintendent, perhaps in conference with others, actually sets the schedule, but it is essential that the shop foreman be in on the layout so that he feels that it is his schedule and not that of a clerk on whom the blame for failure may carelessly be thrown.

In a shop where the planning department had been dropped, the following observation was once made to me: "It's all very well to have a schedule, but the schedule does not get the work." No schedule gets the work out if the foreman does not co-operate with those controlling it by making known the reasons for delays or failures to comply with the requirements of the schedule. A co-operative schedule does not advise the superior officer of delays in order to bring censure on a department, but with the idea of helping out by supplying more men, more machines or by redistributing work that is accumulating in one place so that the final completion dates may be met. When a schedule department tries to run independently of the shop, then it fails because it "does not get the work." When it operates in conjunction with the shop or when it is run, as advocated by the writer, "by the shop," then it succeeds because it is simply a concerted effort to attain a single aim.

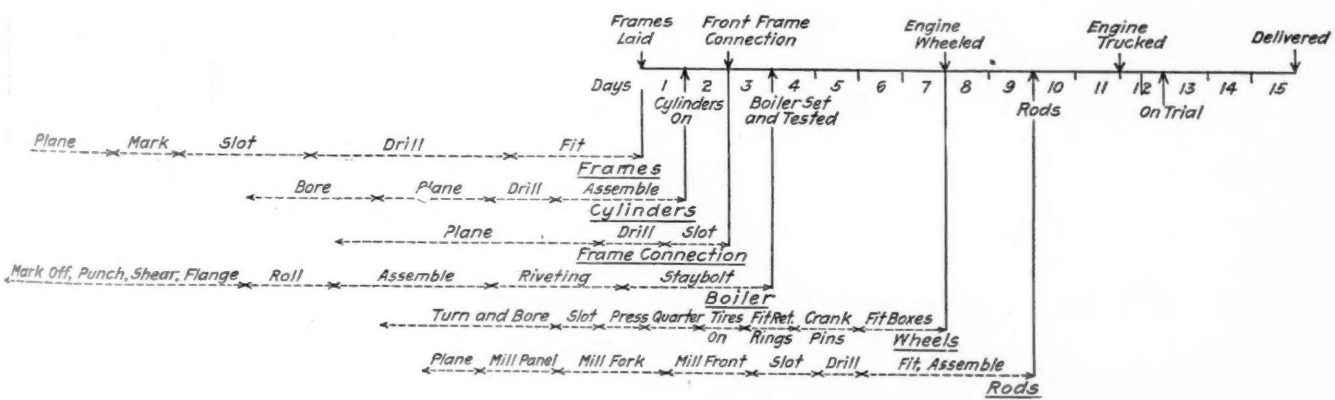
The following is a description of the Canadian Pacific production department methods as they are at present applied at the Angus Shops, Montreal. The methods of taking care of new work will first be followed, after which the same principle as applied to the repair work will be taken up.

For the purpose of this description the Locomotive Department only will be considered, the output being new and repaired locomotives, although it should be understood that the principles apply to all classes of output in all shops.

ROUTING AN ORDER OF NEW ENGINES

We will assume an order is placed to build a number of engines of a certain class and the management desire them completed by a certain date determined from past experience, a general survey of conditions and the known capacity of the shop. After the first one is delivered the balance is required, say, at the rate of four engines per month.

In all cases the first engine is desired as early as possible. In order to determine the best possible date of delivery of this first engine it must be found out which parts will take the longest time to deliver to the erecting floor and which parts have the most machining on them, since the delivery date can only be accurately computed when these larger items are scheduled. A list must be made up of all the large items: frames, boiler, cylinders, etc. Opposite each item on this list all the operations that have to be done on it are entered. Next the time each operation will take must be estimated. Adding up the time required by all the operations gives us the total machining or operation hours for each piece. To this time must be added an allowance of about five hours for each succeeding operation to take care of delays due to movement of material and awaiting attention at the next operation. It is evident that there must be some overlap at each machine to avoid constant delays while waiting for work. These times all totalled and divided by the number of available



This illustrates the method only and is not to correct scale

Fig. 2—Method of Determining the Date of Completion of the First of a Run of New Locomotives

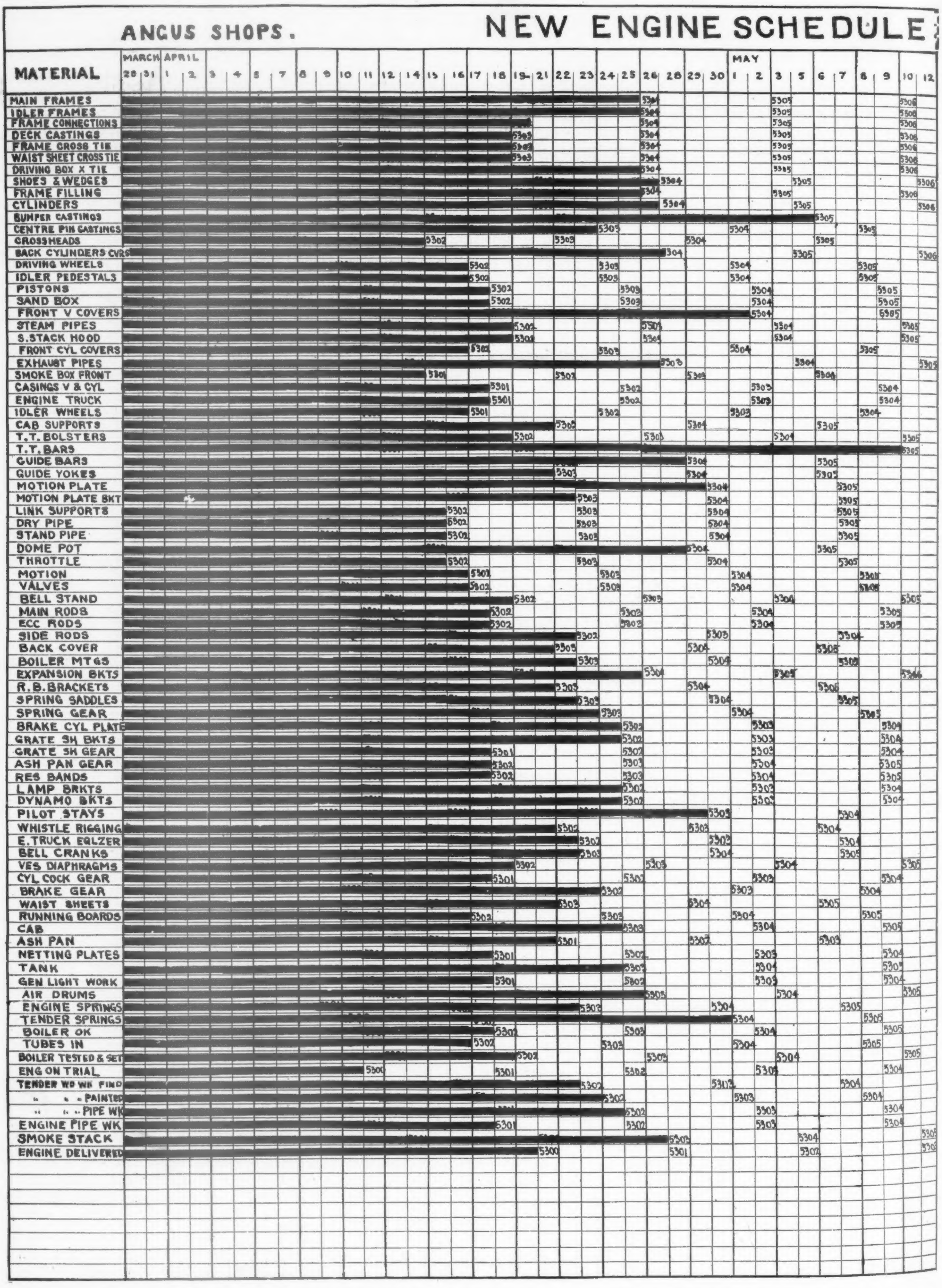
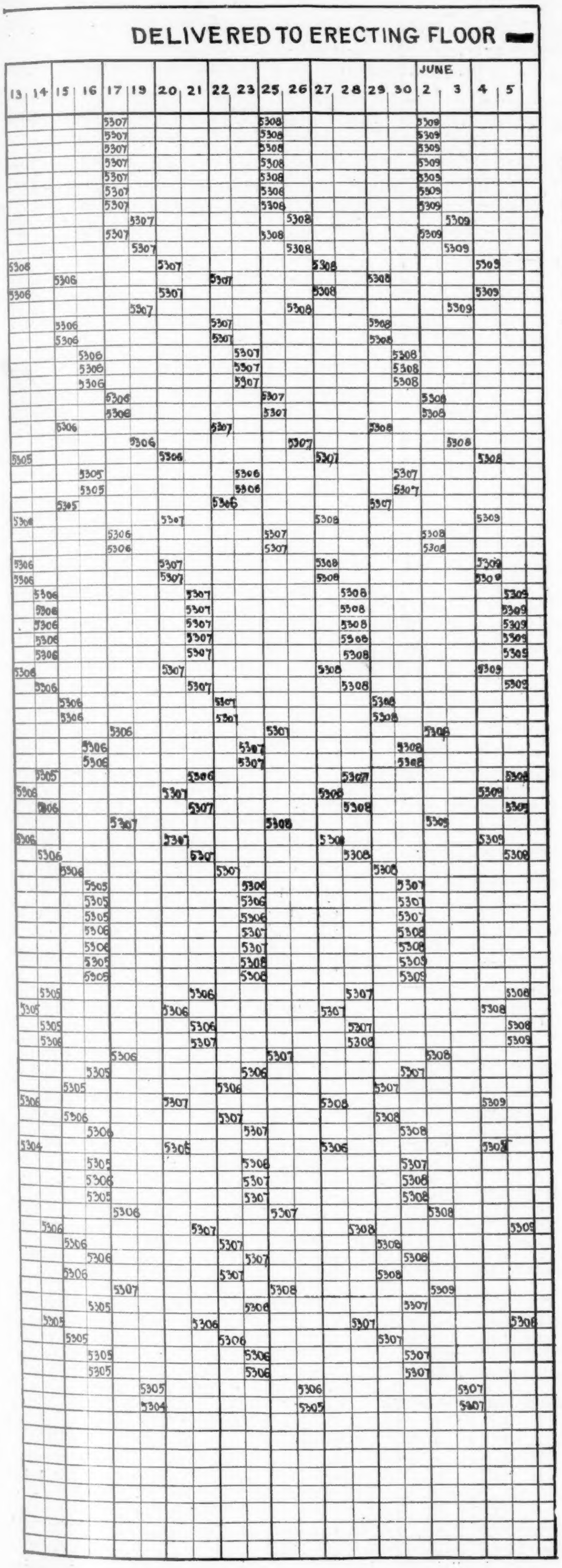


Fig. 3—Standard Schedule Form Prepared for an Order of New Locomotives, Showing the Method of Checking Off the



Completed Work by Extending the Heavy Lines

working hours per day give the number of days required for machining. In the case of castings the line-up must begin with the delivery of drawings to the patternmaker, time to make the patterns, time to cast, time to deliver and then all shop operations up to the delivery on the erecting shop floor. In cases where material, such, for instance, as plates for

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS
PRODUCTION DEPARTMENT
A P R I L 1 9 1 9
SECOND PERIOD WEST MACHINE SHOP

DATE	GUIDE BARS	MOTIONS	VALVES	BELL STANDS	MAIN RODS	SIDE RODS
April 7th	513 5301	3293 5300	5300 3293	741 1996	5300 1042	3293 5300
8th	3356 471 3955	2066 3356 3418	2066 3378 613	760 5300 2066	2066 3529	1042 2066
9th	848 3288	5301	3356 3418	810 613	3378 613 2599	810 3378
10th	3476 5070	3356 3410	5301 471	3356 3418	3356 3418	613 2599
11th	513 3408	471 3955	3955 2209	471 5301	471 5301	3356 3418
12th	5302 1109	2209 848	848 3376	3955 2209	3955 2209	471 5301
14th	3960 2601	3476 2053	2053 3288	848 3476	848 3476	3955 2209

Fig. 4—A Weekly Order-of-Work Sheet for Machine Shop Operations

boilers, is not in stock an allowance of the time required to secure delivery must also be included; obviously it is futile to set a scheduled date and expect to live up to it unless this provision is made. Purchased finished material must also be taken into account because the engine cannot be delivered minus any part.

Having determined the date of delivery of the frames,

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS
PRODUCTION DEPARTMENT
A P R I L 1 9 1 9
ERECTING MACHINE SHOP
Delivery dates of material to Erecting Shop

DATE	GUARD STAYS	SPRING GEAR	BRAKE GEAR
Still due	848	2209	3418 3955
April 14th	3476 1109	848	2209
15th	2053	3476 1109	848 1109
16th	6169 3288	2053	3476
.17th	3408	6169 3288	2053
19th	3475	3408	6169 3288
21st	5070	3475	3408
22nd	2601 3492	5070	3475

Fig. 5—A Weekly Order-of-Work Sheet

boiler and other large parts, eight days are added for erection up to the wheeling date and, say seven days more, which gives a final delivery date. Thus a final delivery date is arrived at on the basis of which a complete schedule for everyone to work to is built up, onto which all the various de-

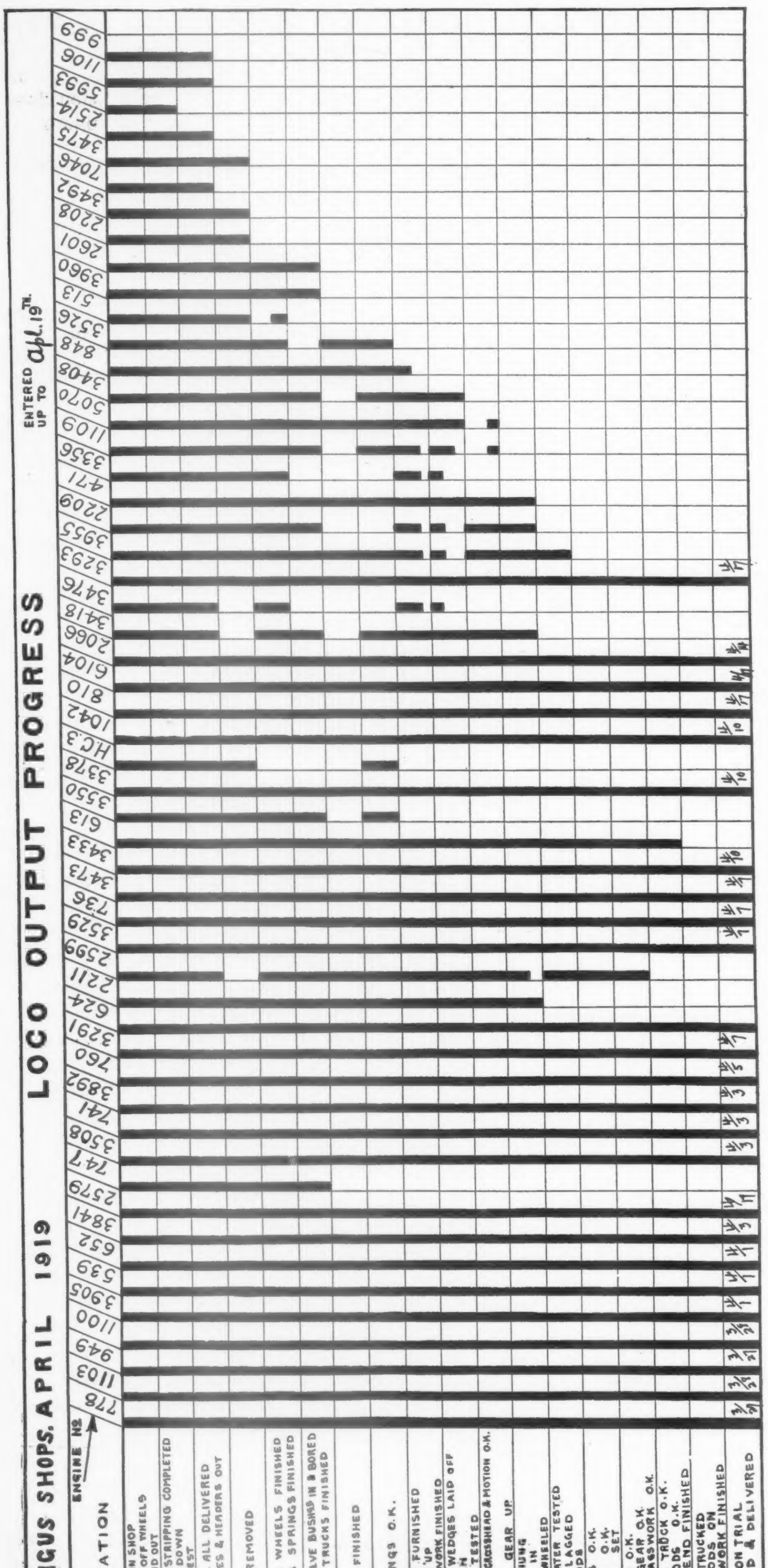


Fig. 6—A Graphical Presentation of the Progress of Engines Through the Shop

tails can be added showing the required delivery dates from all departments.

To determine the dates to be marked on the master schedule, the writer uses a graphic method which is simple and less liable to error than plain tabulation. Fig. 2 is a sample of such a computation, which is made on section paper, hours being shown on the horizontal scale. Starting with the last operation in each group, at the point when it is required to be delivered to the erecting floor and working backwards, all items are entered to scale. The final result in hours is easily converted to days, and actual dates entered on the master schedule. From this all the different shop foremen and chargehands are given details of finishing dates for the different operations and parts.

Our practice is then to take one of our standard schedule forms, Fig. 3, which are 24 in. by 22 in., and list all parts down the left-hand side. Along the top are inserted the dates of all working days and in the squares corresponding to the correct delivery dates for each part the engine numbers are entered. Having determined the proper date for the first engine, as illustrated in Fig. 2, it is a simple matter to insert the numbers for successive engines at regular intervals of six days or whatever is necessary to show their respective delivery date.

We thus build up a master schedule which is the foundation of the system and is also of much value to the shop managers to show them just how each engine stands. As each part is delivered a production department man crosses out the items by extending the thick black lines in each case, thus giving a graphic and plain representation of the situation and incidentally emphasizing items not on time for his personal investigation.

At the Angus Shops engine repairs as well as new engines are being handled and in order to condense the instructions both new and repair engine dates are included on the same sheet. The object is to give each shop foreman but one order-of-work sheet covering the work of his department.

According to the nature of the work in each department, either weekly or daily order-of-work sheets are issued, samples of which are shown in Figs. 4, 5 and 7. These sheets go to the foreman actually directing the workmen, and are copies of that part of the master schedule which concerns each particular foreman for the day or week, as the case may be. It is the duty of the production department men to check over every shop every day with the foreman to determine whether all work scheduled is completed or whether and why it is de-

layed. On his return to the office the production department man marks up the master schedule and then issues the next day's sheets. These are always issued before quitting time in the evening so that foremen can lay out their work ready for the next day.

The first line of each order-of-work sheet is labelled "Still due" and represents work that was due but not delivered on time. A summary from all sheets of the work which is late is given every day to general shop foremen and the shop superintendent for their personal attention. It is thus seen that the whole work is covered by a checking system that releases the foremen and management generally, from a chore which previously occupied a considerable portion of everybody's time, giving more time for taking care of shop difficulties, of which there are always plenty.

ROUTING REPAIR ENGINES

For routing engine repairs a master schedule form slightly different from that for new engines is used. The difference

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS

PRODUCTION DEPARTMENT

DAILY ORDER OF WORK SHEET

STRIPPING OPERATIONS FOR APRIL 8th, 1919.

ERECTING SHOP:

Engine 2601	S.B.front, headlamp dynamo and rails. Main and side rods, grates, brake gear, engine off wheels, dome casing pump.
Engine 2228	Engine off wheels X -
Engine 513	Motion and valves X Steam and exhaust pipes X Headers out, mountings stripped and delivered, dry pipe and stand, pipe out. All parts cleaned and delivered, buffer beam and pilot if required.
Engine 3960	Engine off wheels, Pump X Hydro test, motion and valves, spring gear, steam and exhaust pipes.

TANK SHOP:

Engine 2601	Netting and plates out
Engine 3960	Netting and plates out, ash pan removed.
Engine 513	Ash pan removed

BOILER SHOP:

Engine 3546	Tubes out and removed X
Engine 848	Ditto X

JACKET SHOP:

Engine 2601	Strip firebox complete for test
Engine 2228	Ditto Strip cylinder casings and jacket.
Engine 513	Ditto

X means one day late.

Fig. 7—Daily Order-of-Work Sheet for Stripping Operations

is, however, only in the form, because of the number of engines to be carried. A line is provided for each part or section of the work scheduled and working dates are carried across the tops, as in Fig. 3. One month only is carried on the repair schedule, whereas over two months are represented on the new engine schedule, each form having been found to be the convenient size to cover the conditions to be taken into account in each case.

As each engine arrives at the shop an inspection is made for missing and broken parts, report of which is checked up with the road report of repairs to be made. From these the general foreman with the chief scheduleman of the production department, decide how many days in the shop are to be allotted to the repairs. The scheduleman then proceeds to apply a ten, fifteen, eighteen, etc., day standard schedule to the engine, adding in where necessary an allowance for such specific repairs as broken frames, new cylinders or heavy boiler work. After this the engine number is entered on the master schedule under the correct date for each operation and then included on the daily order-of-work sheet as they come due.

All acquainted with engine repair work know that there are delays due to unforeseen boiler work or unreported defects that are not discovered until after stripping, which necessitate setting back some dates and advancing others as the work progresses. This condition is taken care of by the production department by issuing the form shown in Fig. 8, to those concerned. It is not issued to such departments as are able to get ahead on their work without interfering with the general program. It is good policy not to change any schedule unless absolutely necessary. If a department can handle its work on the original layout, it is better to let them do so, even if the work is not needed on the date scheduled. This policy reduces shop costs because foremen do not have to break in on work that may be started to give preference to something else.

Since the primary object of the production department is to reduce the time and cost of the work, delays and their causes are of great interest to us. The direct effect of routing work is to reduce the time between jobs, and this is especially important in that it increases the capacity of the shop without additional pit space.

A production system of this kind is very much comparable to the recording gages in a power plant. The sheets show clear all the time the work comes through on time, but if a department for any reason gets out of order, just as the gages

CHANGE OF DATE NOTICE

Date ......April 17th......

Foreman......West Machine......

Please note that out Date of Engine......3516......

has been set back on account of......New Tube Sheet......

Engine is re-scheduled for......May 15th......

Schedule Dept.

Fig. 8.—Form Used to Notify the Foremen Concerned, of a Change in the Schedule

in the power house show trouble, so will the record of "lates" show it in the shop and continue to do so until the trouble is rectified. This, of course, is exactly what is aimed at.

A weekly progress sheet is shown in Fig. 9. This is issued to all general foremen and piece-work foremen as a means of general information to those not getting detail order-of-work sheets. It gives the engine number, class of repair, date in shop and date scheduled out, of every engine being worked on in shop. This information thoroughly posts all concerned on the general shop standing. One file of these sheets, with all engine reports, is kept in the general foreman's office, where the master schedule board is also located, so that all can see them and watch the shop progress insofar as it concerns them. By making all production department information and data available in this way, every foreman becomes conversant with how it all is developed and consequently has confidence in it. This confidence begets results.

The method of making up and checking the order-of-work sheets has been described, but a little further information may be of interest. Fig. 4 shows a machine shop sheet covering deliveries of guide bars, motions, valves, bell stands, main rods and side rods. In this department, as on other work of similar character, is shown all principal work due for a week. In this case the work of more than one chargehand is shown on the sheet; this is simply to economize on the typing which comes in a rush at the end of each day. On Fig. 5 it will be noted that four engines show on the "Still due" line, and naturally get first attention. Fig. 7 is one of the daily operation sheets which is issued to the stripping

gang bosses. Here it is seen that the exact operations to be performed are enumerated, and it can readily be appreciated that when a department which is falling down gets a sheet of this kind the information is of the real helping-hand nature because the planning is already done. In our case the stripping of engines now takes just 50 per cent of the time it did three months ago, a result which has been accomplished simply by distributing the gang according to the daily order-of-work sheets.

Another chart of interest to the shop management is the graphical representation of engine progress. Fig. 6 contains along the top all the engines in the shop in the order in which they came in. On the left is listed in 54 items the principal work in the order in which it is to be done on a general repair. As each item is completed the black line is extended downward towards the bottom horizontal line, which represents completion of the engine. This chart is also used as a check on output, but principally as a check on costs. It instantly gives a line-up on the engine progress, which is compared with a corresponding line on another chart which represents the cost to date.

It is equally as important to keep a check on engine costs as on output. As soon as practicable after the receipt of com-

CANADIAN PACIFIC RAILWAY CO.

ANGUS SHOPS

PROGRESS SHEET, WEEK ENDING APRIL 5th 1919.

Div.	Engine	M.	T.	F.B.	Date in shop	Out shop
Q	2658	3			3-19	3-31
A	3508	1	1		3-7	4-1
O	3841	2	1		3-5	1
Q	3943	3			3-18	1
A	2552	2	1-1		2-25	2
A	3892	1	1		3-18	2
O	736	1	1-1		3-19	2
O	741	1	1		3-8	3
O	170	1	1-1	4	1-9	3
O	1996	1	1-1	2	1-3	4
Q	3284	1	1		2-19	4
Q	6104	1	1		3-25	4
	5300		New Engine		3-19	5
Q	760	1	1-1		3-11	5
O	3433	1	1-1		3-17	7
Q	3473	1	1		3-18	7
N B	3529	1			3-15	7
Q	3378	1			3-24	8
N B	3293	1			3-27	8
Q	810	1			3-21	9
Q	709	3			3-22	9
	5301		New Engine		3-27	10
O	1042	1	1-1		3-21	10
O	2599	1	1-1		3-14	11
O	3418	1			3-27	11
D A	40				4-	11
O	613	1	1-1		3-20	12
A	7083	1			4-	12
O	2209	1			3-28	12
O	2066	1	1		3-25	12
	3476	1			3-28	14
	5302		New Engine		4-	14
A	3955	1			4-	14
Q	3546	3		W	4-	15
N B	3356	1			4-	15
O	2053	1	1-1	1	3-28	16
Q	3288	1			4-	16
Q	3408	1			4-	17
Q	5070	1			4-	17
	848	1			4-	19
Q	3520	3		W	4-	19
	5303		New Engine		4-	21
Q	1109	1			4-	21
Q	3388	1			4-	22
A	3483	1			4-	22
O	2054	1	1-1	1	3-28	23
	5304		New Engine		4-	23

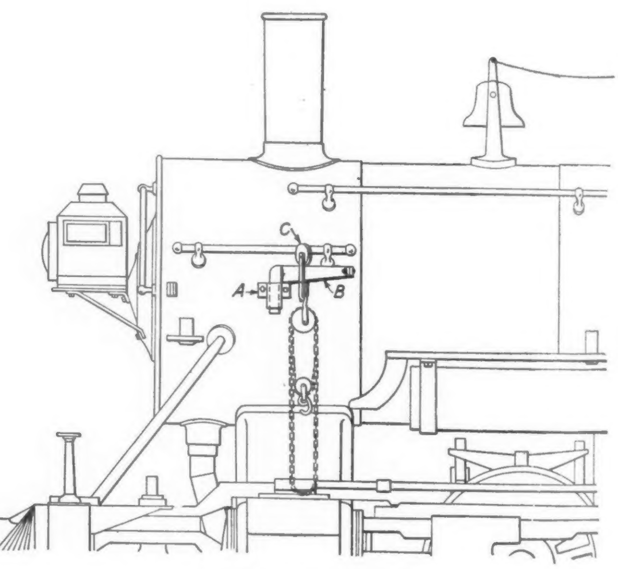
Fig. 9—Weekly Progress Sheet Issued to General Foremen, Who Do Not Receive Detail Order-of-Work Sheets

plete information as to what has to be done on an engine, an estimate of the cost is prepared. This estimate is based on the average cost of the individual class for the past year plus additions for all specific repairs that are known. This total cost is apportioned to the different shops according to the amount of work each has to do, and the whole is graphically plotted daily on a chart similar to Fig. 3, except that the allowance is indicated by a red mark to which the heavy black line of actual cost slowly approaches. From this chart, together with Fig. 9, engines on which the cost is running high quickly can be picked out and the reason learned before it is too late. Often it is found that high costs are due to poor distribution of labor in some particular department, which is brought to the notice of the proper party for rectification.

In common with all other roads, war-time conditions took away a lot of skilled men who knew the back shop practices and brought into our shops a lot of unskilled railway mechanics. But the management is still responsible for getting the output at the right cost. The methods here outlined are in principle the same as laid down at Angus shops by H. L. Gantt several years ago, simply modified to give desired results with minimum expense as present conditions and common sense dictate.

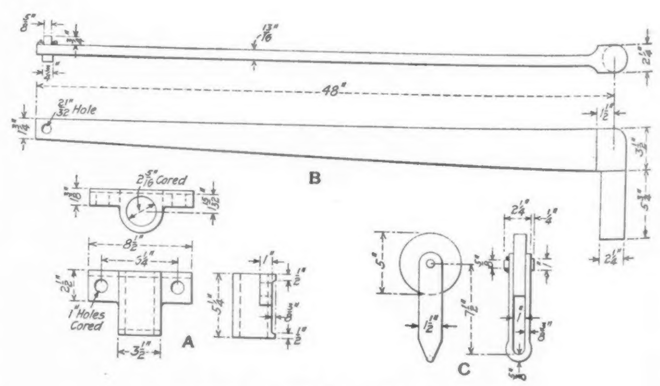
A LIGHT CRANE FOR FRONT END WORK

To facilitate the handling of valves, steam chests, guides and other parts at the front end of locomotives a light capacity crane has been devised in the Duluth & Iron Range shops which is giving very satisfactory service.



Crane Attached to a Locomotive

A cast steel bracket *A* is fastened permanently on each side of the smokebox of all engines. This bracket has a socket to receive one end of a forged steel crane arm *B* fitted with a trolley *C* to which a chain hoist is attached. Two



Details of Bracket and Crane Arm

of these cranes are kept in the main roundhouse and one at each outside point where repairing is done.

This crane may also be used for any other light work in the roundhouse or shop by placing the brackets *A* in convenient places such as at presses, for handling crank pins and driving box brasses.

Meeting of the Fuel Association

Fuel Conservation Problem Discussed by a Large Attendance at the Eleventh Annual Convention

The International Railway Fuel Association held its eleventh annual meeting May 18 to 22 at the Hotel Sherman, Chicago.

ADDRESS OF PRESIDENT PYLE

Mr. Pyle in his opening address made a plea for economy in fuel, speaking in part as follows: Those who have not had a practical working knowledge of the conditions under which the railroads labored during the past year have no conception of the task which has confronted all connected with the movement of transportation. The railroads have

L. R. Pyle (M. St. P. & S. S. M.)
President

C. M. Butler (A. C. L.)
Vice-President

J. B. Hurley (Wabash)
Vice-President

H. B. MacFarland (A. T. & S. F.)
Vice-President

J. G. Crawford (C. B. & Q.)
Secretary-Treasurer

been the backbone of our war preparation and without them we would have failed miserably.

They will also be the backbone of our country during the reconstruction period, and it behooves every man connected with the American railroads seriously to consider just what part he is to perform. We will be called upon to do things which at first glance appear almost impossible of accomplishment, not because what we will be asked to do is impracticable but because of the difficulty of getting others to put these things into practice. If we are the men for the job we must get results and this will be the measure of our ability as railroad men. Regardless of who operates the railroads during the coming year this fact is clear and unequivocal. It will be necessary to produce better transportation facilities, both freight and passenger, at a lower cost than ever before. Wages and cost of supplies entering into the operation and construction of a railroad are higher than ever before. To offset this we must eliminate waste.

There is a wide field for discussion as to how economy can be realized on the locomotive, in the roundhouse or stationary plant, by the transportation man in more efficient methods of train handling, by the mechanical man through better maintenance of locomotives and cars, by the maintenance-of-way man through better track conditions and fewer slow orders, or by the car and air brake man in maintaining the air brake system and so taking care of lubrication to eliminate hot boxes, or by the yardmaster in making up trains efficiently.

The results obtained through effecting economies in fuel are far-reaching and assist in speeding up the movement of transportation, which, in turn, effects other economies. Everything done to save coal has a beneficial effect on all other angles of railroad operation. Even now operating officials do not fully realize the tremendous opportunity for a material reduction in the cost of transportation by special-

izing on the second largest item of expense on a railroad, namely, that of fuel.

Although some roads have and are eliminating fuel waste through systematic efforts, we have as yet barely scratched the surface. To get the real reduction in cost that is possible and absolutely necessary a more practical interest has to be shown by general operating officials and a closer co-operation must exist between the heads of the different departments. This does not mean that there is no co-operation between the heads of the different departments, but to continue fuel conservation in a haphazard manner the maximum economy can never be attained.

A fundamental principle of fuel conservation is co-operation, as even the slightest error in one department often disturbs the entire organization. A chain is no stronger than its weakest link, and a federal manager can have ever so good a fuel organization, but if a superintendent fails to co-operate fully there is a break in the chain and the railroad suffers. It is not so much individual effort that is needed as a practical give-and-take co-operation from the chief operating official to the smallest individual on a road.

Hale Holden, regional director of the Central Western region, was to have delivered an address, but was unable to attend. W. B. Storey, federal manager of the Atchison, Topeka & Santa Fe, spoke, in part, as follows:

We who are handling the railroads are vitally interested in saving fuel. We must save fuel in order to get back to normal conditions. On the Atchison, Topeka & Santa Fe the fuel bill for engines alone was one-third of the total transportation expenses and one-seventh of the total operating expenses during 1918.

There are many difficult phases to the problem. If we could make fuel economy the prime consideration, the matter would be greatly simplified, but service to the public must receive the first attention. Another serious phase is the labor situation which we must handle differently from what we did in the past. We must get these problems before the men as matters that concern them and the railroads with which they are connected.

ADDRESS OF FRANK McMANAMY

The position of the Railroad Administration is in many ways analogous to that of a tenant, the landlord being represented by the corporate interests. The landlord whose rental is fixed hesitates to make improvements which do not have the effect of increasing his revenue regardless of the saving they may effect for the tenant; for that reason it is necessary for us to do our best to make savings with the equipment, facilities and the organization we have.

It is comparatively easy to make a substantial saving in the cost of locomotive fuel by wholesale application of recognized fuel saving devices. However, the application of these devices involves charges to capital which must be borne by the railroad corporations and the acceptance of these charges by the corporation is not always easily obtained. But if we can not install those improvements which will effect fuel economy, there is no reason why we should not maintain in thoroughly good condition those devices with which locomotives are equipped, nor any reason why we should not make every effort to save fuel by eliminating waste of steam and water.

Conservation of fuel from the Railroad Administration standpoint requires careful supervision by the Fuel Conservation Section and close co-operation on the part of practically every department in the Railroad Administration, and in this the International Railway Fuel Association can be especially helpful. Fuel economy is not, as a rule, accomplished by saving one huge sum, but the huge sum which it is possible to save is made up of the accumulated results of many small items. We gain nothing from conventions unless we make use of the knowledge obtained. It is easy to attend a convention of this kind, and by discussion bring out some most valuable points in connection with conservation of fuel, but it requires real courage and perseverance to go back home and consistently practice what we preach.

Conservation of fuel is one of the important matters before the Railroad Administration during the period of government control, and will be no less important when that period has passed. It is the desire of the administration to have the sympathetic co-operation of the International Railway Fuel Association and all of its members as individuals in effecting the conservation of fuel. The administration desires to co-operate with the members of the Fuel Association in the purchase, inspection, weighing, distribution, handling and accounting for fuel, as well as in its economical use to bring about the greatest possible saving.

The administration will aid in every possible way and will be helpful in every way that a central organization can be under the present method of operation, but if we are to be successful we must have teamwork in getting the very best we can out of what we have.

OTHER BUSINESS

A report on Front Ends, Grates and Ash Pans was signed by H. B. MacFarland (A., T. & S. F.), chairman; W. J. Bohan (N. P.), E. B. DeVilbiss (Penn. Lines), J. P. Neff (Am. Arch. Co.), and Frank Zeleny (C., B. & Q.).

A report on Pulverized Fuel was signed by W. J. Bohan (N. P.), chairman; H. T. Bentley (C. & N. W.), H. B. Brown (L. V.), R. R. Hibben (M., K. & T.), D. R. MacBain (N. Y. C.), J. H. Manning (D. & H.), H. C. Oviatt (N. Y., N. H. & H.), John Purcell (A. T. & S. F.) and L. R. Pyle (U. S. R. A.).

Other papers submitted were: Teamwork of Enginemen and Firemen; Locomotive Fuel Losses at Terminals; What Can a General Operating Officer Do to Promote Fuel Economy? Certain Essentials; Dirt in Coal; Equated Tonnage and Its Relation to Fuel Consumption; Lame Engines and Their Effect on Fuel Consumption; Storage of Coal by Railroads During 1918; Fuel Department Organization; Co-operative Research and the Railway Fuel Problem; The Effect of Reducing Exhaust Nozzles to Overcome Front End Air Leaks; Internal Combustion Versus Steam Engine for Small Stationary Plants. Abstracts of these reports and papers will appear in subsequent issues.

THE NEW OFFICERS

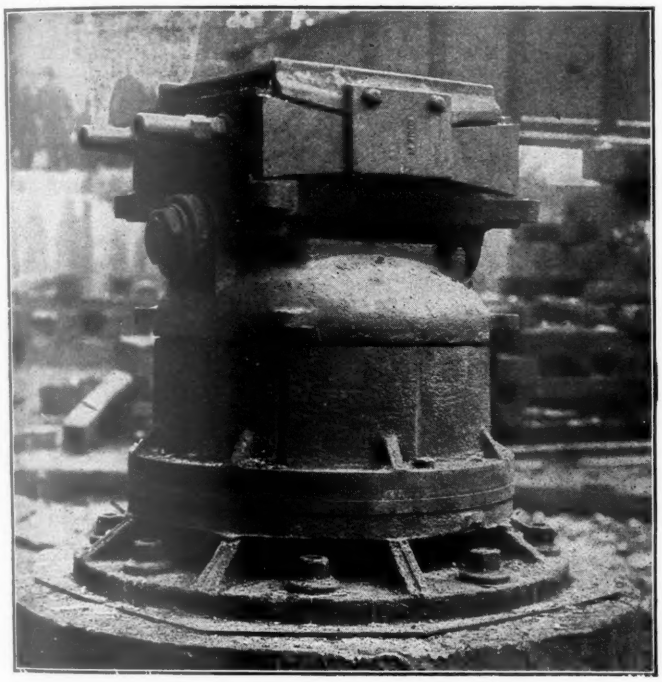
The following officers were elected: President, H. B. MacFarland (Atchison, Topeka & Santa Fe); vice-presidents, W. J. Bohan (Northern Pacific), J. B. Hurley (Wabash), and W. L. Robinson (Baltimore & Ohio Western Lines); executive committee, J. W. Hardy (U. S. R. A.), M. A. Daly (Northern Pacific), C. M. Butler (Atlantic Coast Line), L. J. Joffray (Illinois Central), C. C. Higgins (St. L.-S. F.), and J. M. Nicholson (A. T. & S. F.).

RAILROAD EMPLOYEES' SUBSCRIPTIONS TO VICTORY LOAN.—Officers and employees on railroads under government control throughout the United States subscribed a total of $138,637,250 to the Victory Liberty Loan. The returns from the seven regional directors show that out of a total of 1,841,267 employees, 1,417,042, or 77 per cent, subscribed to the loan. Employees on 13 roads showed subscriptions of 100 per cent. Railroad officials and employees subscribed a total of $184,868,300 to the Fourth Liberty Loan. General offices of regional directors of Southern, Pocahontas, Allegheny, Southwestern and Northwestern regions subscribed 100 per cent, the general office of the Central Western region 99 per cent, and the general office of the Eastern region 96.8 per cent.

A Turntable of Unique Design

P. R. R. Develops Adjustable Center, Supports Table at Three Points and Puts Tractor at Each End

A CENTER bearing, adjustable vertically over a range of 1 in. by means of screw operated wedges, is one of the main features in the 110-ft. turntable recently designed by the Pennsylvania Railroad and now being installed at several of its more important engine terminals. This vertical adjustment has permitted the development of plans for tables of the three-point supported type, the design of which includes many other novel and interesting features and avoids the use of the usual balanced type with its objectionable features, particularly in tables of such extreme length.

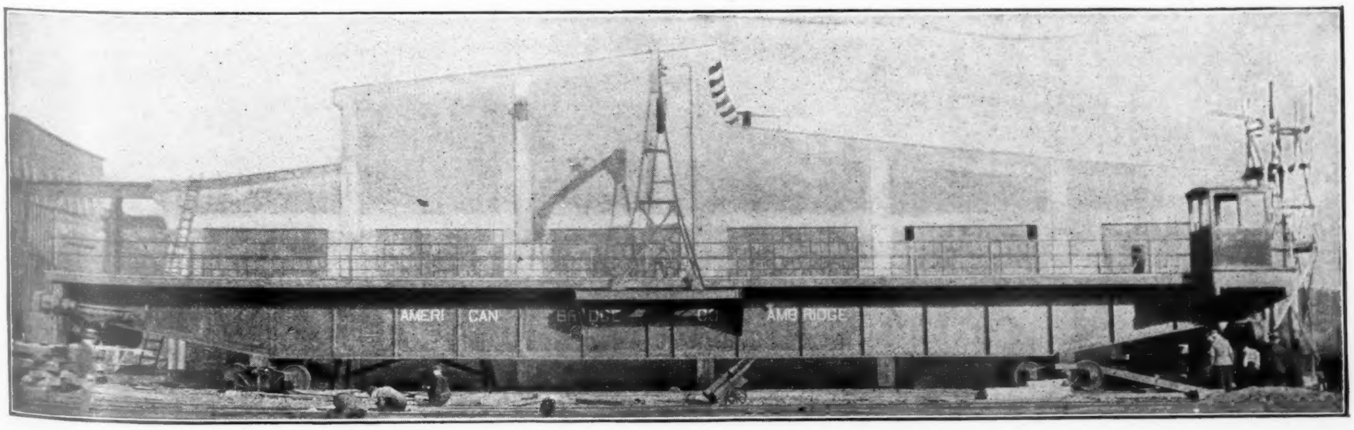


The Center Is Adjustable By Means of Screw Operated Wedges

The 110-ft. tables were designed in anticipation of the increased requirements at engine terminals incident to the impending introduction into service of the new Mallet engines of the HC1s type, several of which are now under construction in the company shops. These locomotives have a wheel base of 97 ft. 3¾ in., an over-all length of 105 ft. 9¼ in., and an estimated weight of 555,000 lb., exclusive of the tanks, which weigh 219,000 lb., or a total weight complete of 774,000 lb. Owing to the extreme depth of girder required for a balanced table of such great length and further because of the conditions under which a turntable must operate, in which it is difficult to spot a locomotive of this size and weight with any degree of accuracy, it seemed inadvisable to build a table of the usual balanced type. Furthermore, the tendency of all balanced type tables to teeter has an undesirable effect on the approach rails and outside trucks, due to pounding, which is augmented as the length increases. It was therefore decided that the new tables should be of the continuous girder three-point supported type, in which the weight of the table and its load is distributed over the center and the four end trucks. Exclusive of the tractors and center the table, ocmplete with the end trucks, has a weight of 75 tons.

Reliability of service and low maintenance costs were the main objectives of the design and in the preliminary studies particular attention was given to the requirements of traction. Time studies were made of the various table operations at existing tables and the information secured was utilized in the design of the tractors to insure that the operating cycles of the new table, with its greater loads, would not exceed those of the smaller tables and that the new tables would easily turn an engine end for end in 45 sec. Special attention was given to starting, accelerating and stopping the table to avoid excessive whip action, with the result that the maximum acceleration does not exceed 0.35 ft. per sec. and the maximum circumferential speed of the table is 240 ft. per min. Reliability of service has further been provided for by the utilization of two tractors, either one of which is capable of moving the table under emergency conditions. The two tractors provide sufficient traction to eliminate the necessity for the use of sand and a separate circle rail for the tractors.

Low maintenance costs are further insured by the permanent type of construction employed throughout the entire structure, including the foundation, the circle wall and rail, the bridge, the deck, and the electrical apparatus. In the design of parts simplicity, accessibility and interchangeability were the objectives. Sheet metal was avoided in the selection of materials and cast iron was used wherever possible



Pennsylvania 110-Ft. Turntable Designed for Three-Point Support

because of its resistance to corrosive action. For the same reason galvanized iron is used for hand rails.

To eliminate the pounding out of the approach rails and approach rail supports at the table ends and at the approach rails, cast steel end ties were installed at the ends of the turntable bridge and iron coping castings were used on the coping walls, the cast steel end ties being aligned accurately to the center line of the table and brought to alignment level by means of stereotype metal between the end tie and the girder flange and secured to the bridge with eight 1-in. bolts. Opposite tracks are also perfectly aligned. The same permanent character of construction is employed in the pit, where the circle rail of Cambria No. 539, 150-lb. section, bent cold, is held in place on 33 iron support castings firmly secured to the concrete.

The adoption of the three-point supported type table permitted the use of girders only 6 ft. ½ in. deep, reducing materially the depth of pit required. These pits are drained from the center to a sump from which the discharge is by gravity or syphon, according to local conditions.

THE ADJUSTABLE CENTER

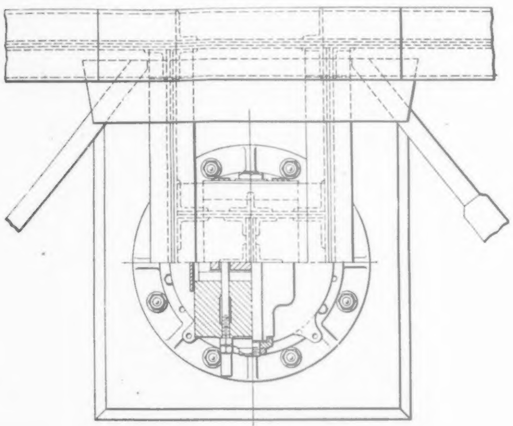
In order that the table function properly on three points of support it was necessary that one of the supports be adjustable so far as vertical alignment is concerned. This adjustment is accomplished in the center by means of screw operated wedges, the total range of adjustment being 1 in. As the load of the table comes down on the sole plate it bears on wedges which in turn bear, through the lower wedge casting, on the equalizing hinge pin, the center of which is at right angles to the longitudinal center line of the table, thence on the thrust bearing proper. This thrust bearing is of the roller type with a babbit liner between the lower roller race and the center casting to insure uniformity of bearing pressure. The load from turntable center is transmitted to the concrete center pier through a ¼ in. linotile liner, which insures a uniform, resilient bearing for the steel casting.

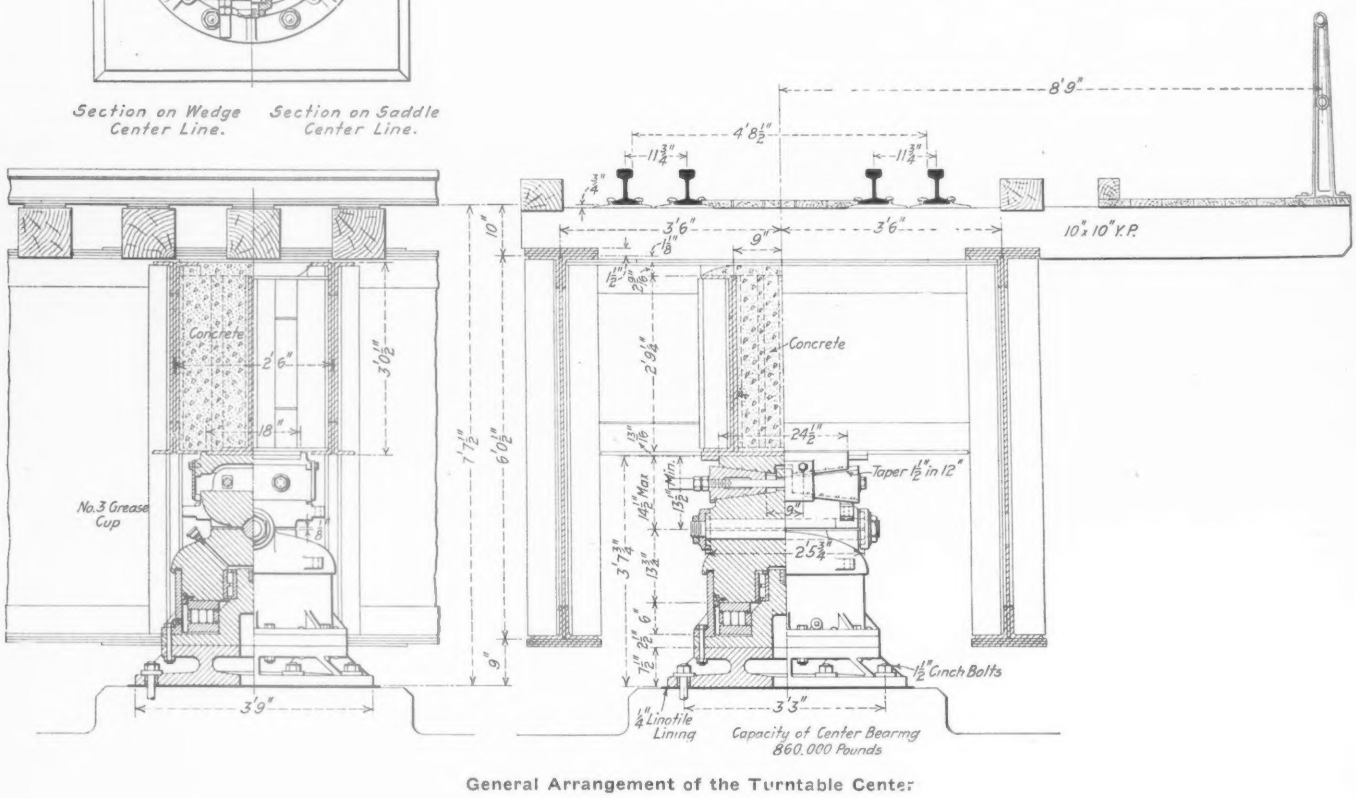
The capacity of the center bearing is 865,000 lb., and it is fully grease lubricated. It has been designed and built with a view of making it accessible for inspection or repairs. The upper half of the center proper can be removed from the base casting and the entire center slid out of position and passed up through the deck of the table. To perform this operation it is only necessary to jack up the table approximately 3 in. All the adjustment wedges and the wedge screws are thoroughly protected against corrosion and grit. The center is all of steel with the exception of the housing shell, which is of cast iron.

TRUCKS

Each end of the table is supported on two, two-wheel end trucks with cast steel frames and hinge connection centers. The hinge casting is provided with a compound angle in order to give proper angularity in all directions. The center line of each hinge pin is in a radial plane passing through the common center of rotation, in which it has vertical angularity sufficient to take care of the circular travel of the truck. The truck wheels are all 30 in. in diameter, coned, with steel tired treads and cast iron centers. They are provided with roller bearing centers with the bearings enclosed in labyrinth casings, the details of which will be made clear by an inspection of the truck drawing, and are fully grease lubricated.

The truck hinge castings as well as the steel end ties on top of the girder are lined to the girder flanges by means of





General Arrangement of the Turntable Center

stereotype metal. The trucks each have a capacity of 186,000 lb. and travel on the same circle rail as the tractors. They may be removed by taking out the hinge pins without removing the hinge castings from the girder.

TRACTORS AND TRACTOR CONTROL

Two tractors are used on each table to give uniform torque action on each end of the table in starting and stopping, as well as to afford reserve power to meet emergency demands. They are operated in multiple from one controller located in a cab on one end of the table.

There are three points of particular interest in connection with the tractors and their control. The first is that two motors are used, one on each tractor, of approximately 30 h. p. each. Considerably more power is required than to operate a type of table in which the locomotive is balanced on the center bearing, but with the two tractors the operation is fast, is always dependable, and in an emergency one of the tractors working alone is capable of operating the table.

The second point of interest is the controller. A type of controller has been developed which is used to control one or both motors, and which may be used on any table of this type, irrespective of the kind of electric power that may be available. The same controller may be used for direct current, single phase alternating current, three phase alternating current and three-wire or four-wire two phase current.

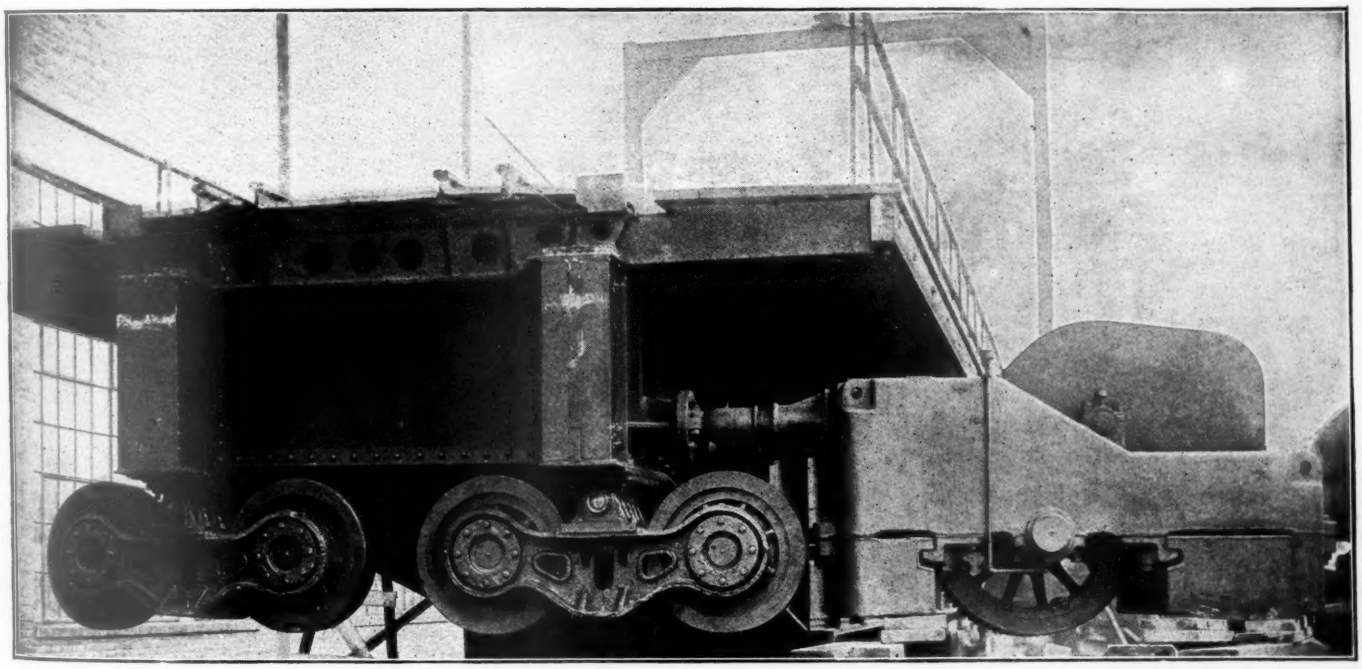
The third point of interest lies in the fact that the motors are equipped with solenoid brakes. The brakes are applied instantly when the controller is moved to the "off" position and are released automatically when power is applied. The brakes are adjusted so that the braking effort corresponds to the maximum torque of the motor. The solenoid brakes make it possible to operate this type of table without any of the so-called locking devices to hold the table in alinement with the approach tracks.

For direct current, 27½ hp. motors are used and 30 hp. motors have been adopted for alternating current. Power is transmitted from the motor to the driving wheels through two sets of gears and an intermediate shaft, with a total gear reduction of 25 to 1. As the tractor is provided with plain cylindrical tires, it was necessary to include in the design a suitable thrust bearing to care for the lateral thrust of the drive wheels. This thrust bearing is located on the inner side of the tractor frame.

In case of accident to either motor or to any part of the driving mechanism, electrical cut-outs are provided for taking the damaged motor out of service without affecting the operation of the other motor, while the solenoid brakes can be blocked in the "off" position. A motor may be disconnected mechanically by removing the split main gear or by removing the motor.

The two tractors engage the table through ball and socket connections located at the end of the stabilizing arms. The relation of the joint locations to the plane of the driving wheel precluded the use of hinge joints. All bearings of the tractors are grease lubricated. Each tractor weighs approximately 23,000 lb. in working order, giving a total tractive effort of 12,000 lb. per table.

The tractor frames on account of the weight required are made of solid cast iron with suitable ballast weights suspended from the lower surfaces. Special attention is given to the machining of all mechanical parts to insure absolute interchangeability for repairs. All gears are fully enclosed against the weather. The tractor wheels have cast iron centers, steel tires and are provided with cast steel cut driving gears. The bearings are all of brass.



The Trucks and Tractor in Place

When operating at night the table is lighted by floodlights on each end which illuminate the approach rail ends. The operator's cab is electrically heated and is lighted only with a small, well shaded lamp to keep down the reflection at night.

CURRENT COLLECTOR

Overhead current collectors for the usual type of turntables must be suspended from the overhead wires, as the portal over the center of the table must move back and forth over a considerable distance when the locomotive is moved on or off the table. Since the three points of support prevent the table from rocking on the center bearing, the collector in this case is bolted securely to the center of the portal.

The collector in itself is of particular interest as it is

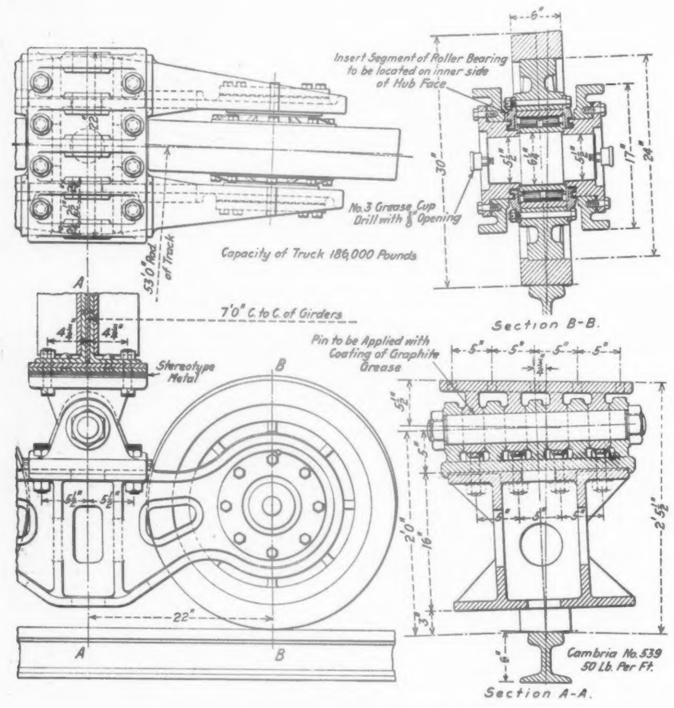
made up of standard parts, bolted together, and may be used for direct current, or one, two or three phase alternating current by simply bolting together the required number of parts. It is weather, gas and steam proof.

Structual steel poles placed on opposite sides of the enginehouse circle support the overhead wire. One messenger wire is provided instead of the usual two, and it is not required to support the current collector. The only function of the messenger is to support the current carrying wires and to prevent rotation of the stationary part of the collector. The messenger is supported rigidly on one tower and on the other is fastended to one end of a weighted bell crank which insures uniformity of tension on the messenger wire at all temperatures.

PIT AND BRIDGE CONSTRUCTION

In order to insure no settlement at the coping wall on account of the pounding received in service, iron coping castings with 1-in. walls were employed instead of wooden sills. These castings are arranged one for each approach track and are thoroughly embedded in and bolted to the concrete. They are accurately aligned to the approach tracks and weigh about 9,000 lb. each, are 5 ft. 6 in. long, 12 in. deep and 30 in. high.

The circle rail on which the trucks and tractors run is 106 ft. in diameter and is supported on 33 castings each



General Arrangement of the Trucks

9 ft. 4 in. long, 10 in. high and 12 in. wide, with ⅞-in. walls. No sand is used in connection with the operation of the tractors because of the ample capacity of the tractors themselves. This feature eliminates the resistance of the sand to rolling of the trucks.

The cast steel end ties on the bridge have a maximum depth of 12 in. a flange width of 5 in. and a minimum width of 8⅜ in. The sections are 1 in. thick. They support both the traction rails and the guard rails and are lined to the bridge girders by means of ⅜ in. of stereotype metal.

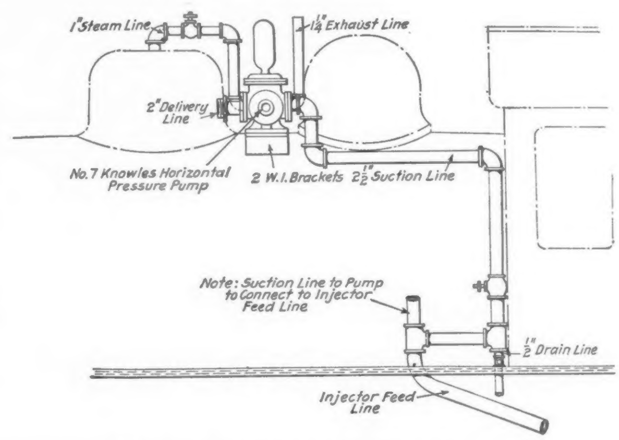
The design of this table was developed under the direction of A. S. Vogt, formerly mechanical engineer, who has now retired.

Tables of this type have been installed at Pitcairn, South Philadelphia, Erie, Kane and Renovo, Pa., and at Gardenville, N. Y. Others will be installed in the near future at Wilmington, Del., Youngwood, Pa., Pitcairn (Pa.) (emergency table) and at East Altoona.

FIRE PUMPS ON SWITCH ENGINES

BY J. H. B.

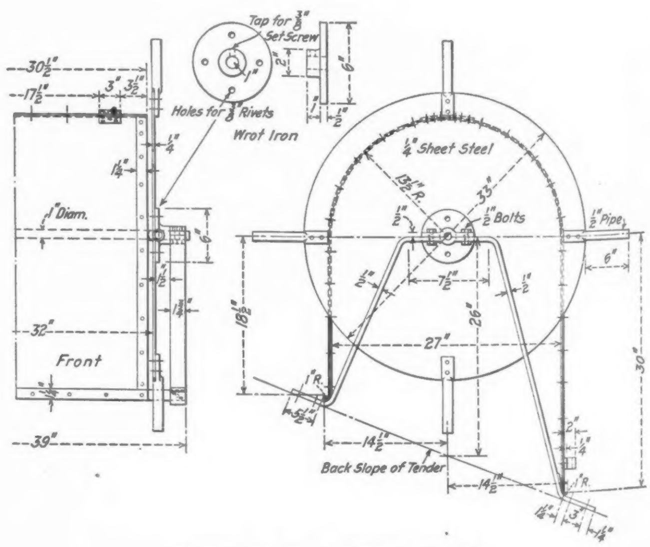
An arrangement for fire pumps on switch engines, in which the pump is mounted on top of the boiler, is shown in the illustrations. A horizontal pressure pump of the capacity required is placed between the sand box and the steam dome with a 1 in. steam line leads from the dome



Fire Pump Installed on the Locomotive

to the pump, which delivers the water through a 2 in. delivery line provided with a hose connection. Water is drawn from the tank to the pump by means of a 2½ in. suction line which connects to the injector feed line just above the running board.

The hose reel is mounted on the sloping top sheet of the tank where it is easily accessible so that in case of fire the



Hose Reel as Applied to Tender

hose can be unreeled readily and connected to the delivery line. Details of the construction and mounting of the reel are clearly shown in one of the drawings.

The protection thus given the various shop buildings and cars in the yard warrants the expenditure necessary to apply the pumps as a switch engine so equipped can quickly reach a fire and becomes a very effective means of reducing fire losses.

Master Boiler Makers' Convention

Over 700 Members Were Present; Report on Drilling Staybolts, Addresses and Other Business

The Master Boiler Makers' Association held its eleventh convention at the Olympic Theater, Chicago, May 26 to 29, with over 700 members in attendance. An address was made by Frank McManamy, assistant director, Division of Operation, U. S. R. A. Mr. McManamy spoke of the benefit to be derived from a full discussion of new methods and practices at conventions and mentioned particularly the importance of some of the topics which had been made the subject of reports to be presented at this meeting. In closing he dwelt on the necessity for thorough workmanship in locomotive repairs.

D. A. Lucas (Prince Mfg. Co.)
President

J. B. Tate (Penn. R. R.)
First Vice-President

C. P. Patrick (Erie)
Second Vice-President

T. Lewis (L. V.)
Third Vice-President

T. P. Madden (Mo. Pac.)
Fourth Vice-President

Following Mr. McManamy's talk, D. A. Lucas, president of the association, delivered the presidential address. Addresses were made by A. G. Pack, chief inspector of locomotive boilers; R. H. Aishton, regional director of the Northwestern Region, and H. T. Bentley, superintendent motive power and machinery, Chicago & North Western.

ADDRESS OF H. T. BENTLEY

Under present conditions a first-class boilermaker is a specialist and no hit-and-miss methods will do; with steam pressure from 150 to 240 lb. per sq. in., the boiler must be maintained in good condition to do its work safely and efficiently, and with the labor-saving devices now in use at all up-to-date shops there is no excuse for not having it in that condition. With the good wages now paid there should be a corresponding increase in output, so that the government we are all working for will feel that the increase given the employees is appreciated and the results obtained justify the action taken.

The railroads before the war had a number of plans to improve the service, and probably nothing in the motive power department would give greater returns for the money expended than the providing of water purifying and hot water washout plants. All of these plans were temporarily side-tracked during the strenuous times just past. Now that the war is over, these plans should again be given early and favorable consideration and plants installed where it is known that the expense is justified. With good water and freedom from boiler troubles, failures on the road and maintenance costs are low; with poor water the conditions are changed, resulting in high maintenance costs, inferior service on the road, delays at the roundhouse and a disgruntled superintendent. Money must be spent either to purify the

water and keep the engine in service or to make frequent repairs and have occasional failures. In my judgment it is far better to furnish good water and obtain good service instead of poor water and poor service.

One important thing that foremen should get together on is the balancing of work so that necessary boiler and machinery repairs will be made while the engine is out of service to enable a locomotive to go out of the shops and perform a proper period of service without trouble from boiler or machinery. On several occasions it has come to my attention that an engine will be out of service, having the wheels dropped and quite heavy machinery repairs and a few weeks afterwards the same engine will come back to shop for new flues or side sheets and, of course, nothing will be necessary on other parts of the locomotive. In this case the engine is out of service for two periods close together, whereas all of the work could and should have been done at the same time.

The electric welding of two-inch boiler flues in back flue sheet is something that interests me. We have tried it and find that with good water the flues don't leak or bridges crack and therefore welding is unnecessary; with poor water it is very desirable to do this if you do not run into other troubles. We bought 26 new boilers some time ago and specified that the two-inch flues should be welded, and after three or four months service the flue bridges cracked and new flue sheets had to be applied. The welding of superheater flues appears justifiable by reducing troubles on account of leakage and overcoming engine failures, and if this is so successful, I cannot see why the welding of small flues would not be a good thing.

The federal locomotive inspection department has been responsible for a great improvement in the condition of locomotive boilers, etc., and a closer co-operation on the part of the mechanical officers with the inspectors will bring about a still greater improvement.

APPLICATION AND DRILLING OF TELL TALE HOLES

The best method in all cases to apply tell tale holes is before the staybolt is applied. This may be done on an automatic drilling machine or a small drill press rigged up for this in the shop. The most economical and best method to cut the bolts off is with the oxy-acetylene torch, in this way not disturbing the bolt in the sheet as is done with a hammer or a chisel bar, or staybolt nippers.

It is the practice in one shop to punch the tell tale hole in the staybolt on a forging machine in the blacksmith shop. This is done in one heat in two operations; first a rather blunt tool is used which punches a hole about 3/8 in. in diameter to about 5/16 in. depth, which acts as a countersink on the end of the bolt; the bolt is then raised in the die and a 7/32 in. hole 1½ in. deep is punched. It is our opinion that this is the best method known of applying tell tale holes in staybolts. If the dies are properly made the result will be a bolt of proper size with the tell tale hole in the center.

For drilling tell tale holes we use a 7/32 in. high speed twist drill both in new bolts and in opening up old tell tale holes. However, where holes are forged as above mentioned, we do not find it necessary on new bolts to use a drill as the holes can be very easily opened with a taper pin. The lubricant used is composed of soft soap and water, both for drilling and for opening up new bolts.

The report was signed by Louis R. Porter (Soo Line), chairman, A. N. Lucas (C. M. & St. P.) and Barnard Wulle (Big Four).

OTHER BUSINESS

Reports on Application of Brick Arches to Fireboxes: Design of Ash Pan and Draft Appliances and Bracing of Locomotive Tenders were submitted by committees and will appear in a later issue.

The products of 47 different companies were exhibited at the convention.

There was an attendance of 745 members at the convention, and during the convention 198 applications for membership were received.

The following officers were elected for the ensuing year: President, John B. Tate, foreman boilermaker, Pennsylvania Railroad, Altoona, Pa.; first vice-president, Charles P. Patrick, general boiler inspector, Erie Railroad, Cleveland, O.; second vice-president, Thomas Lewis, general boiler inspector, Lehigh Valley, Sayre, Pa.; third vice-president, Thomas P. Madden, general boiler inspector, Missouri Pacific, St. Louis, Mo.; fourth vice-president, Edward W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul, Dubuque, Iowa; fifth vice-president, Frank Gray, foreman boilermaker, Chicago & Alton, Bloomington, Ill.; treasurer, William H. Laughridge, foreman boilermaker, Hocking Valley, Columbus, O.; secretary, Harry D. Vought, New York City. The following were elected members of the executive board to serve for three years: E. J. Reardon, district inspector, Interstate Commerce Commission, Chicago; Thomas F. Powers, foreman boilermaker, Chicago & North Western, Oak Park, Ill.; Harry F. Weldin, foreman boilermaker, Pennsylvania Railroad, Philadelphia. Henry F. Wandberg, foreman boilermaker, Chicago, Milwaukee & St. Paul, Minneapolis, Minn., was elected to the executive board for one year.

E. W. Young (C. M. & St. P.)
Fifth Vice-President

H. D. Vought,
Secretary

F. Gray (C. & A.)
Treasurer

Locomotive Repair Shop Output

A Proposed Formula for Measuring and Comparing the Cost of Repairs in Relation to the Output

BY HENRY GARDNER

THERE have been a great many formulae proposed for measuring the output of a locomotive repair shop or for the purpose of comparing the output of two or more shops. All are more or less in error and no one of them will give figures which can be relied upon to state positively which one of two shops delivered the largest output per man or indicated the most able and successful management.

The old method of equating or listing repairs by classes is very unreliable. A Class 3 repair in one shop may cost twice as much as in another, and the amount of work done will vary in proportion. When you compare two shops on this basis, the superintendent having the smaller output will at once start to tell you of the superheaters, stokers, valve gears, etc., that he put on and the other man did not. He will also show you a list of flue sheets, side sheets, etc., greatly in excess of similar work done by the competing shop. The size of the power, weight, and wheel arrangement and cost of repairs will then be brought into the argument as factors rightly having a decided bearing upon the exact quantity of work performed in the shop. Finally the argument is dropped just where it started; no definite and satisfactory conclusion could be made.

It has been generally conceded that the cost of repairs to a locomotive varied almost in direct proportion to its weight. Ernest Cordeal in an article describing a method for determining shop output by means of cost units (Engineering Magazine, May, 1915), states that "The cost of identical repairs will usually vary in direct proportion to the total weight." This may be correct if parts of engines or jobs are considered. For example, the cost of repairs to main rods might run higher on a large engine than a small one, but if the entire repair is considered the cost per ton weight of engine will be found to vary, in most shops, in some inverse proportion to the weight. Assuming that costs of repairs vary directly as total weight of engine, the tonnage repaired was added up and this figure divided into the total cost to get the cost per ton. The result was arbitrarily called a "work unit," and the lower the unit the better the showing for the shop considered.

Another method consisted of adding up these units to indicate quantity of output delivered and then comparing the totals. It amounts to the same thing whether we add up the costs per ton of all engines delivered or call the average cost per ton a "unit" and multiply this unit by all the tonnage delivered. The final result simply reduces itself to a cost per ton comparison of output.

The simple output formula described above was found to be closer to facts than the older methods and might in some cases fairly measure the shop rating. Weight is an important element in output and total labor and material costs vary almost directly as the quantity of work performed. A large engine, as a whole, would usually cost more to repair than a small one, provided exactly similar work was performed on each, but the cost per ton for the large engine (Mallets and engines under 50 tons total weight excepted) is found to be less than for the small one.

Pursuing this course further the writer has developed an arbitrary formula which closely represents the quantity of shop output. This formula gives no rational figures that can be used for statistical or accounting purposes, but it has a legitimate and proper value when used exclusively for making comparisons. Bearing in mind that the cost per ton of the majority of repairs varies inversely as the total weight, it is apparent that we must compensate in some manner for this variation. In other words we must devise a formula which will give proper credit for the Mallets and small power. Such a formula would read as follows:

$$\text{Total cost per equivalent work unit} = \frac{\text{Total labor and material cost}}{\text{Total work units} \times \text{a constant}}$$

Referring now to Fig. 1, a curve is shown which approximates a parabola. Plotting this curve for a large number of repairs developed the fact, for the repair shop considered, that the cost of repairs per ton varied in inverse ratio to the total weight for engines weighing between 50 and 180 tons. The total labor and material cost to repair an engine weighing 100 tons will average $34 a ton (four classes of repairs averaged together), but an engine weighing 50 tons will average $60 a ton. This unexpected result may be due partly to the tendency on most roads to run up the mileage between shoppings on small branch line engines and switching power.

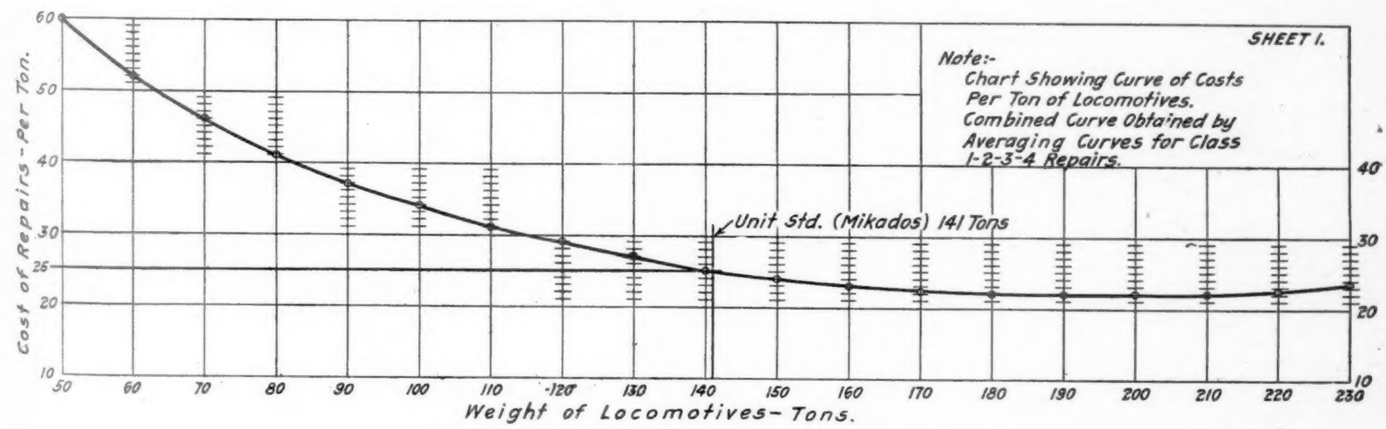


Fig. 1—Cost of Repairs Per Locomotive-Ton Curve

It is also the case that patterns, castings and blue prints for small, out-of-date engines are not as easily located as for the larger modern power. There is also considerable work to be done on small boilers and fireboxes in order to meet present government regulations.

In the formula given above the total cost per equivalent work unit is our output measure. This is derived by dividing the actual labor and material cost of the repairs (for one month or any period desired) by the work (cost) units multiplied by a constant. As the total cost of the repairs increases in the numerator of the fraction the total work units, to a degree, will correspondingly increase in the denominator, since the work units result primarily from the money expended. One work unit is arbitrarily taken as \$20 labor and material cost in order to make the quotient come out in easily comparable whole numbers.

It is evident that this formula is fair and logical for all cases. When the numerator gets credit the denominator will also get a varying amount of credit. But since the work units are fixed and based upon averages, and the total cost is an actual quantity, any extraordinary increase in expenses due to overtime or improper management will be reflected in the actual total cost figures. This increase will correspondingly raise the quotient and indicate the abnormal conditions present. The converse of this is of course equally true.

The constant used in the formula needs some explanation. Referring again to the curve (Fig. 1) we find that an engine weighing 100 tons will cost \$34 per ton, and an engine weighing 141 tons will cost \$25 per ton. It is now evident that to give the lighter 100-ton engine the proper credit for its greater cost per ton we must multiply the work units for that engine by 34 ÷ 25, or 1.4. It is through this constant that the tonnage of output becomes a factor. By using the formula we are now able to give shops turning out a large proportion of Mallets or small old-fashioned power due credit for the quantity of work performed.

Substituting concrete values in this formula we will have, for a 100-ton engine, Class 3 repairs:

$$\frac{\$4{,}000}{(120 + 60)\ 1.4} = \$16\ (\$15.87 \text{ actual}) \text{ cost per equivalent work unit.}$$

Where 4,000 = actual labor and material cost from shop accounts
120 = standard work units allowed for straight Class 3 repairs
60 = work units allowed for betterments as per list (Fig. 3)
1.4 = constant from the curve (Fig.1)

It may be explained that the standard Mikado locomotive and some heavy Pacifics weighing about 141 tons were taken as unity for the constant scale. The work units for 141-ton engines will then be multiplied by constant 1.0 and the equivalent will not differ from the actual. This weight was chosen for starting the scale for the reason that engines of these types represent a large percentage of the power repaired and cost figures covering repairs to such engines were found to be most uniform and reliable. The work units are now compensated for the variation of cost of repairs with weight of engine in exactly the same manner as steam tables show the equivalent evaporation from and at 212 degrees, the boiling point of water.

An examination of Fig. 3 shows how the extraordinary work and betterments applied to the regular repairs are listed under 36 items. It was thought best to include small flues and radial stays in this list since credit could then be adjusted for full or partial sets if desired. Each item is given a current cost unit figure based upon actual average costs, including overhead, covering all classes of power for a considerable period. Dividing these costs by 20 gives in each case the number of straight cost units expended for each item. The units here shown were adopted in 1917

UNIT OUTPUT SHEET ______________ SHOPS ____________ 1919 SHEET 3

	CLASS OF WORK	STD. UNITS	ENG. NO.	1431	1968	4044	1246	1447	1530	2016	2145	2801	2811	2869	4097		1265	1653	1803	4064	2374	M
			REPAIR CLASS	1H	1BH	1	1B	2H	2B	2H2	2	2H	2	2	2H		3B	3	3	3	4FT	4F
			WT. TONS	106	91	141	72	106	74	86	138	110	110	110	141		73	84	91	141	97	
1	Course Sheet	8																				
2	Roof Sheet	20																				
3	Throat Sheet	10																				
4	Side Sheet-Outside	11																				
5	Wrapper SH-Inside Crown and Sides	28																				
6	Back Head	17																				
7	Front Flue Sheet	4		X	X			X		X		X	X		X							
8	Dome Sheet	3																				
9	Crown Sheet	16																				
10	Back Flue Sheet	7								X												
11	Side Sheet-Inside	10							X				X	X								
12	Door Sheet	9																				
13	Set Radials	8																				
14	Set Flues-Plain	8																			X	
15	Frank. Auto. Fire Door	5																				
16	Smokebox Sheet	2																				
17	Each New Cylinder	14																				
18	Univ. Steam Chest	32								X												
19	New WH. Center	5		X				X														
20	New Driv. Axle	3		X				X		X		X							X			
21	Set New Tires	18		X	X	X		X	X		X	X				X		X	X		X	
22	Baker Valve Gear	50								X												
23	Power Rev. Gear	14																				
24	Chambers Throttle	6																				
25	Each Frame Rep'd	3			X		X		X								X					
26	New Frames-Two	40								X												
27	New Wood Cab	6																				
28	New Steel Cab	11									X											
29	New Superheater	75		X	X			X		X		X			X	X						
30	Set Flues-Super.	2																				
31	Add. Air Pump	8																				
32	New Stoker	78																				
33	New Tend. Frame 12A-Steel	32		X	X			X														
34	New Tend. Frame-Wood	3					X		X									X				
35	Steel Bumper	5																				
36	Boy. Speed Recorder	5																				
37																						
	Total Units																					

Fig. 2—Tabulation of Repairs by Individual Item

and will not apply to present day rates, as costs will necessarily vary from year to year and need periodical revision.

Fig. 2 indicates how these cost items are checked off for a whole month's output for the shop under discussion. Fig. 4 shows how the data from Fig. 2 is compiled and made ready for applying to the output formula. The last column gives the solution or, "cost per equivalent work unit." For

SHEET 2

LOCOMOTIVE COSTS

NO.	CLASS OF WORK	LABOR	MATERIAL	TOTAL	UNITS	REMARKS
1	COURSE SHEET				8	ALL COSTS INCLUDE COSTS IN ALL DEPARTMENTS SCRAP CREDIT & OVERHEAD
2	ROOF SHEET				20	
3	THROAT SHEET				10	
4	SIDE SHEET - BOILER				11	
5	WRAPPER SHEET - INSIDE CROWN & SIDES - 1 PIECE				28	
6	BACK HEAD				17	VALUE 1 UNIT = $20.00 LABOR & MAT'L
7	FRONT FLUE SHEET				4	
8	DOME SHEET				3	
9	CROWN SHEET				16	
10	BACK FLUE SHEET				7	
11	SIDE SHEET - FIREBOX				10	
12	DOOR SHEET				9	
13	FULL SET RADIALS				8	
14	SET OF FLUES - PLAIN				8	REPAIRED
15	FRANKLIN AUTOMATIC FIREDOOR				5	
16	SMOKE BOX SHEET				2	
17	EACH NEW CYLINDER				14	
18	UNIVERSAL STEAM CHEST				32	
19	EACH NEW WHEELCENTER				5	
20	EACH NEW DRIVINGAXLE				3	
21	SET OF NEW TIRES				18	
22	BAKER VALVE GEAR				50	
23	POWER REVERSE GEAR				14	
24	CHAMBERS THROTTLE				6	
25	EACH FRAME REPAIRED				3	
26	NEW FRAMES TWO				40	
27	NEW WOOD CAB				6	
28	NEW STEEL CAB				11	
29	NEW SUPERHEATER				75	SUPERHEATER FLUES INCL.
30	SET OF FLUES - SUPERHEATER				2	REPAIRED
31	ADDITIONAL AIR PUMP				8	
32	NEW STOKER				78	
33	NEW TENDER FRAME - 12A - STEEL				32	
34	NEW TENDER FRAME - WOOD				3	
35	STEEL BUMPER				5	
36	BOYER SPEED RECORDER				5	
37						
38						

Fig. 3—Unit Value of Repairs

a final decision this column should be averaged by periods or classes as desired. Fig. 5 is used for summarizing cost units by classes of repairs and by months. Fig. 6 which shows graphically how the labor and material costs vary,

SHEET 4.

CLASSIFIED LOCOMOTIVE REPAIRS

SHOP. 1919.

LOCO. NO.	WORK UNITS	CONSTANT	EQUIVALENT WORK UNITS	COST LABOR	COST MATERIAL	COST TOTAL	COST PER EQUIV. WK. UNIT	REMARKS
1431	307	1.3	400	1407	2318	3725	9.3	
1968	278	1.7	473	1598	1926	3524	7.5	
4044	168	1.0	168	2268	2628	4896	29.1	
1246	156	2.1	328	1523	2298	3821	11.6	
1447	266	1.3	347	1476	1104	2580	7.4	
1530	149	2.1	313	1577	933	2510	8.0	
2016	315	1.7	536	2601	2818	5419	10.1	
2145	149	1.0	149	2243	3281	3524	23.6	
1265	133	2.1	279	1613	1131	2744	9.8	
1653	151	1.9	287	1481	1298	2779	9.7	
1803	151	1.7	257	1493	1553	3046	11.8	
4064	130	1.0	130	1574	1261	2035	15.6	
2374	108	1.5	162	1483	1485	2968	18.3	
Motor	25	1.0	25	132	320	452	18.1	

Fig. 4—As Classified from Sheet 3

when applied to the 36 items shown on Fig. 3, is of interest but has no particular value for applying the formula.

This procedure involves a considerable amount of work and a familiarity with shop repair records, but there is no known short and easy way to accurately compare shop output if a reliable decision is required.

It may be well to state that repair costs vary with different shops, and if a nicer comparison is desired, separate cost units can be worked up for each shop. This should of course be done if the above methods are employed to compare the relative efficiency of shops on different roads, as different operating methods and facilities will vary the costs considerably. Another refinement could be made by constructing separate cost per ton curves for each class of repairs instead of using the composite curve shown in this article. The repairs should then be separated by classes and the constants obtained from the corresponding curve for that class. Separate curves indicate that Class 1 repairs cost more for light tonnage than other classes, Class 2 and 3 repairs follow the composite curve closely and the

SHEET 5.

CLASSIFIED LOCOMOTIVE REPAIR COSTS

	SHOP	COST OF REPAIRS LABOR	COST OF REPAIRS MATERIAL	COST OF REPAIRS TOTAL	TOTAL EQUIV. WORK UNITS	COST PER UNIT ACTUAL	COST PER UNIT STANDARD	REMARKS
JANUARY	CLASS 1							
	2							
	3							
	4							
	TOTAL							
FEBRUARY	CLASS 1							
	2							
	3							
	4							
	TOTAL							
MARCH	CLASS 1							
	2							
	3							
	4							
	TOTAL							

Fig. 5—Monthly Summary Sheet

Class 4 repair curve shows a more nearly uniform cost for all tonnage, as would be expected. These repair classes should conform to the standards adopted by the United States Railroad Administration.

The formula and principles described in this article have been used for checking the relative output of several shops and the results have substantiated the opinions of those competent to judge by other methods combined with experience. This work could be drawn much finer, and instead of using only 36 betterment items, 100 could be taken,

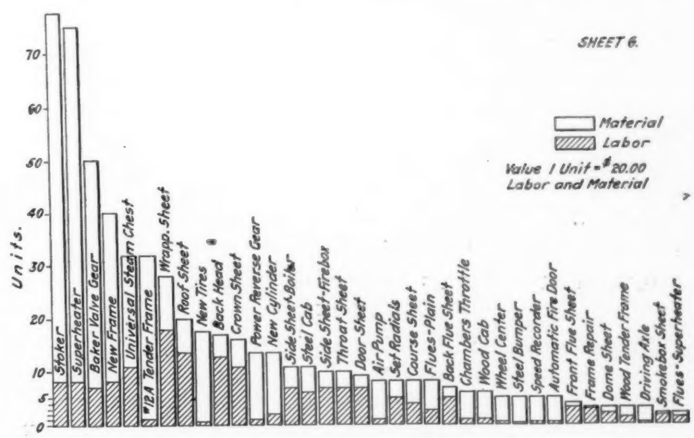


Fig. 6—Comparative Cost

or all the work performed on the engine could be itemized directly from service and material cards, but it is felt that the method shown is simple and inexpensive and serves the purpose. Moreover it is questionable whether service and material cards as made out in the majority of railroad shops are as accurate a guide as the averages here obtained. Using this same relative cost unit data for all shops puts all on the same basis and no one shop could claim that service and material cards or clerical compilations were in error.

This subject is important and one which has never yet been satisfactorily settled. What is needed is a measure that will equal the foot rule when applied to the output of locomotive repair shops, and until such a measure is accurately constructed no one is in a position to state positively that one shop is well or poorly managed or that the output is greater or less when making comparisons with other shops.

Railroad Administration News

About 19,000 Standard Cars Stored Awaiting Acceptance by the Roads to Which They Are Assigned

Approval has been given to issuance of Pullman annual passes to general chairmen of shop crafts, to be made good on railroad or railroads over which such general chairmen have jurisdiction, and also on such foreign lines as they may hold railroad transportation over, which has been furnished to them for the purpose of enabling them to make short cuts between points on the lines over which they have jurisdiction.

Application for these passes should be made by the federal managers to the director, Division of Operation, at Washington.

385,000 Surplus Freight Cars

The net surplus of freight cars on May 1 was 385,447, including nearly 20,000 on Canadian roads, according to reports compiled by the Car Service Section. This represents a larger number of idle cars than has been recorded at any time since April, 1908, except on March 1 and April 1 of this year. On March 1 the net surplus stood at 473,080 and on April 1 it was 446,685, so there was a reduction during April of 61,000.

Punitive Overtime Up to Director General

The question as to whether the train service employees are to be allowed a punitive rate for overtime is again up to Director General Hines for decision. The brotherhoods have reiterated since the Railroad Administration has been in control their demands for time and a half for overtime which was waived during the negotiations which preceded the enactment of the Adamson law. When Supplements 15 and 16 to General Order No. 27 were issued by Director General Hines in April the matter was referred to Board of Adjustment No. 1 for a report. The board, however, was not able to agree, and has submitted two separate reports, one of which presumably represents the views of the brotherhood representatives on the board, while the other represents the views of the managers of the roads. Before deciding, Director General Hines has ordered an investigation as to the cost of paying punitive overtime in road service.

Mechanical Officers Instructed to Report on June Conventions

Frank McManamy, assistant director of the Division of Operation, has addressed the following to the regional directors, asking that mechanical officers be instructed to make written reports regarding their observations at the June conventions:

"The convention of Section 3, Mechanical, American Railroad Association, which is composed of the Master Car Builders' Association and American Railway Master Mechanics' Association, will be held at Atlantic City, June 18 to 25.

"It is desired that the representative members from the different railroads attend, as far as possible, and that other mechanical department officials who are members be permitted to attend for at least a portion of the time, where they can be spared from their regular duties without adversely affecting the service. It is anticipated that there will be on exhibition the most complete collection of mechanical appliances that has ever been exhibited at one of these conventions, and a study of it will be of substantial value to the mechanical department officers who are in attendance.

"In order to obtain the greatest possible amount of benefit from this convention, it is desired that each member present below the rank of superintendent of motive power shall, on his return from the convention, make a written report to the superintendent of motive power, relative to the new devices which he inspected at the convention, or ideas which he obtained from the discussions which can be applied with profit to the work under his direction.

"The superintendent of motive power will make a digest of the various subjects presented in this way, so that those which can be profitably adopted may be given consideration, sending a copy of it to the assistant director, Division of Operation, in charge of the mechanical department, for the use of the Committee on Standards for locomotives and cars.

"Will you please issue the necessary instructions?"

Comparison of Car and Locomotive Repairs in 1917 and 1918

The following table showing comparisons regarding car and locomotive repairs in 1918 and 1917 was included in a general statement filed by Director General Hines with the Senate Committee on Interstate Commerce, showing the expenses of the Railroad Administration:

Repairs to Locomotives and Cars Combined, 12 Months, January to December, 1917-1918

	1918	1917
Average number of serviceable freight locomotives	30.824	30,378
Average number freight locomotives in or awaiting shop	4,624	4,286
Per cent freight locomotives in or awaiting shop	15.0	14.8
Average number freight cars in service	2,430,786	2,363,309
Average number freight cars in or awaiting shop	138,989	133,252
Per cent of freight cars in or awaiting shop	5.7	5.6
Total number of locomotives receiving repairs requiring more than 24 hours	235,522	193,924

Comparison of Freight Cars Repaired by Railroads Under Federal Control, 1917 and 1918

(1) Number of freight cars repaired by 133 Class I railroads and 22 Class II railroads, showing separation between light and heavy repairs:

	Light	Heavy	Total
1917	29,207,081	1,941,380	31,148,461
1918	27,650,214	2,005,926	29,656,140
Increase, 1918 over 1917	....	64,546	....
Decrease, 1918 over 1917	1,556,867	....	1,492,321

(2) Number of freight cars repaired by 6 Class I railroads that were unable to give complete separation between light and heavy repairs:

1917	1,112,966
1918	1,154,085
Increase, 1918 over 1917	41,119

(3) Total number of freight cars repaired by 161 railroads, representing ownership of 2,357,208 cars:

1917	32,261,427
1918	30,810,225
Total decrease, 1918 over 1917	1,451,202

(*a*) Referring to item (1), showing decrease of 1,556,867 light repairs, 1918 over 1917, with an increase of 64,546 heavy repairs: The reduction in light repairs is due to reporting light running repairs, requiring less than one 1-man hour to repair, in 1917, which were not permitted reported in 1918.

(*b*) Item (2) shows substantial increase, 1918 over 1917.

(*c*) Item (3). Explanation for total decrease, 1918 over 1917, is given in paragraph (*a*).

Allocation of Equipment

Of the 100,000 freight cars ordered by the Railroad Administration in 1918, 44,542 had been built up to April 30 and 92,750 had been assigned to various companies, but only 25,570 had been accepted, while 18,972 of the cars already built were in storage at the car-building plants. The numbers of the various types are shown in the table.

Numbers and Types of Cars Built by the Railroad Administration Not Yet Accepted by the Railroads

Type of cars	Number of cars
40 ton double sheath box cars	3,702
50 ton single sheath box cars	1,169
50 ton composite gondolas	6,043
55 ton steel hopper	8.057
70 ton low side gondolas	1
Total	18.972

Of the 1,930 locomotives ordered, all but 41 had been assigned, but all the assignments had not been accepted. The locomotives have been accepted as fast as they have been built, but various companies have objected to the assignments just as they have to the cars. Some of the objections are based on the inability to finance the equipment, some on the statement that the cars or engines are not needed, and some are based on the types, although the Railroad Administration has allowed the roads to exchange one type for another where it can be done before the builders have progressed too far with the building or the ordering of materials to make the change.

The circulars sent out by the regional directors asking for information as to the number and types of locomotives that will be required and whether the corporations will be willing to purchase locomotives of their own standards represent an effort to place some of the unaccepted locomotives, but it will not be possible to substitute individual or "made-to-order" designs for the standard types in many instances because the work on the parts for the standard types has been so far advanced.

Plans for the creation of an equipment trust to finance both the cars and locomotives by a single issue of equipment trust obligations amounting to approximately $400,000,000, instead of having individual securities issued by each of the roads, are under consideration by the Association of Railway Executives and the Railroad Administration.

COSTS OF TRAIN AND LOCOMOTIVE SERVICE

A monthly report is being compiled by the Operating Statistics Section of the Railroad Administration which shows the itemized costs of locomotive service per locomotive mile, and train service per train and 1,000 gross ton miles. The figures for February and March, 1919, compared with the same months a year ago are shown in the table. No comparisons are made with last year on the gross ton mile basis.

The comparisons with last year are disturbed to some extent by the factor of back pay being included in this year's figures, while last year's figures do not include the increases in wages which became effective later in the year. Most of the figures for March, however, show decreases as compared with February.

NUMBER AND COMPENSATION OF EMPLOYEES

The January, 1919, pay roll of the Class I railroads under federal control was $230,800,589 for 1,848,774 employees, as compared with $153,039,988 for 1,703,748 employees in December, 1917, according to a statement compiled by the Operating Statistics Section, which shows the effect of the wage increases during 1918 as between the different classes of railway employees, together with the numbers, the days and hours worked, the compensation per day and per hour, and the percentage of change in the unit compensation for each of the 68 classes prescribed by the Interstate Commerce Commission. The average increase in unit compensation was 48 per cent, the range being from a 20 per cent reduction for general officers receiving $3,000 per annum and upwards, up to 98 per cent increase for structural iron workers and 99 per cent for "other yard employees."

The increase in the number of employees was 145,026 or 8.5 per cent and the average compensation per employee in January was about $125, as compared with about $90 in December, 1917. This would amount to an average of $1,500 per year, as compared with an average for the year 1917 of $1,004.

COSTS OF TRAIN AND LOCOMOTIVE SERVICE

	February, 1919	February, 1918	March, 1919	March, 1918
Cost of locomotive service per locomotive mile	120.7	106.3	119.2	100.1
Locomotive repairs	40.2	31.5	40.1	30.7
Enginehouse expenses	10.4	7.4	10.2	6.7
Train enginemen	18.8	20.3	18.8	18.8
Locomotive fuel	47.3	43.9	46.3	41.0
Other locomotive supplies	4.0	3.2	3.8	2.9
Cost of train service per train mile	169.3	155.0	167.5	145.1
Locomotive repairs / Enginehouse expenses	57.7	45.2	57.1	43.4
Locomotive fuel	54.0	51.1	52.6	47.6
Other locomotive supplies	4.6	3.7	4.4	3.3
Train enginemen	21.5	23.6	21.3	21.8
Trainmen	25.1	26.6	25.6	24.4
Train supplies and expenses	6.5	4.8	6.5	4.6
Cost of train service per 1,000 gross ton miles	126.5	....	119.5	....
Locomotive repairs / Enginehouse expenses	43.1	....	40.8	....
Locomotive fuel	40.3	....	37.5	....
Other locomotive supplies	3.4	....	3.1	....
Enginemen and trainmen	34.8	....	33.5	....
Train supplies and expenses	4.8	....	4.6	....

The largest increases in the number of employees are shown in the mechanical department. A considerable reduction is shown in the number of train employees, attributable to the decreased volume of traffic.

A comparison of the number of employees and their ocmpensation in December, 1917, and January, 1918, is presented in the table for the various classes of mechanical department employees and the men in the engine service.

ORDERS OF REGIONAL DIRECTORS

Superheaters.—The Eastern regional director, by circular 500-1-97A728, authorizes the application of superheaters to locomotives where all of the needed material is already on hand. The corporations must be consulted, but if material is on hand such consultation need not cause delay.

Record of Work at Enginehouses.—The Eastern regional director, by circular 1801-127A748, sends to federal mana-

NUMBER AND COMPENSATION OF EMPLOYEES IN OR ASSOCIATED WITH THE MECHANICAL DEPARTMENT (MONTH OF JANUARY, 1919, COMPARED WITH MONTH OF DECEMBER, 1917—CLASS I ROADS UNDER FEDERAL CONTROL)

Class of employee	Number of employees, Jan., 1919	Number of employees, Dec., 1917	Compensation Per day, Jan., 1919	Compensation Per day, Dec., 1917	Compensation Per hour, Jan., 1919	Compensation Per hour, Dec., 1917	Per cent change in unit compensation
General foremen—M. E. department	1,745	1,665	8.31	5.00	....	....	66
Gang and other foremen—M. E. department	21,399	18,429	6.77	4.23	....	....	60
Machinists	54,382	42,973	....	....	.719	.509	41
Boiler makers	16,960	13,469	....	....	.713	.504	42
Blacksmiths	9,925	8,369	....	....	.707	.494	43
Carpenters (includes other departments)	56,057	50,848	....	....	.579	.350	65
Painters and upholsterers (includes other departments)	11,064	9,878	....	....	.613	.382	60
Electricians	12,061	9,894	5.38	3.22	....	....	67
Air-brake men	7,328	5,846	....	....	.604	.359	68
Car inspectors	24,902	20,763	....	....	.597	.323	85
Car repairers	81,799	66,443	....	....	.568	.366	55
Other skilled laborers (includes other departments)	57,674	55,201	....	....	.624	.374	67
Mechanics' helpers and apprentices	110,870	92,018	....	....	.471	.296	59
Enginehouse men	71,066	60,439	....	....	.423	.242	75
Other unskilled laborers (includes all departments)	122,881	104,050	....	....	.413	.246	68
Hostlers	9,908	8,493	....	....	.506	.329	54
Yard engineers and motormen	19,800	20,355	....	....	.688	.541	27
Yard firemen and helpers	20,694	20,821	....	....	.485	.340	43
Road freight engineers and motormen	31,974	32,923	....	....	.825	.707	17
Road freight firemen and helpers	34,409	35,549	....	....	.616	.456	35
Road passenger engineers and motormen	11,810	13,826	....	....	.987	.898	10
Road passenger firemen and helpers	11,622	12,433	....	....	.694	.559	24

gers revised instructions for reporting, monthly, the number of man hours worked at enginehouses. This report goes to Frank McManamy, Washington.

Report on Reclamation of Materials.—The Northwestern Regional Purchasing Committee, in supplement 7 to circular 10, gives a list of items of material being reclaimed by various roads in this region. The list is long and detailed, containing about 800 items.

Preparation of Box Cars for Grain.—The Central Western regional director in a letter dated April 17 calls for immediate attention to the preparation of box cars for grain, and the providing of well-adapted temporary grain doors where needed.

Annual Passes for Employees.—The Eastern regional director, by circular 2100-9A750, advises federal managers that where an employee requires an annual pass over other than his home road, that pass should include also his transportation over the home road, so that he will carry only one pass for all.

Sanitary Maintenance of Cars, Shops, Etc.—The regional director, Eastern region, by circular 500-97A705 advises federal managers that a committee is at work standardizing the rules for practice in the maintenance of sanitary conditions in cars, shops, offices, etc. The committee wants copies of all such regulations now in effect.

Blacksmiths' Convention.—The regional director, Eastern region, by circular 102-37A745, approves the annual convention of the International Master Blacksmiths' Association, to be held at Chicago, August 19, 20 and 21. Each road will follow its usual practice in regard to allowing blacksmiths to attend.

Tinners' Convention.—The regional director, Eastern region, by circular 102-36A738, and the Northwestern director, by circular 77-1-93, announce approval of the convention which is to be held by the American Railroad Master Tinners', Coppersmiths', and Pipefitters' Association in June. Federal managers exercise their own judgment as to granting leave of absence and giving passes.

Employees' Passes for Conventions.—A. H. Smith, regional director, Eastern region, by circular 2100-37A716, advises federal managers that employees regularly elected as delegates to conventions of their brotherhoods are to be granted free transportation both ways; and ordinarily these passes will be issued at Washington. Trip passes for side trips should be requested and secured through the usual channels.

Violations of Inspection and Safety Appliance Laws.—The Central Western regional director in a letter dated April 19, states that, from the large number of reports which are being made by Interstate Commerce Commission Inspectors to the assistant director of the Division of Operation covering violations of federal inspection and safety appliance laws, it is evident that either the railroad inspectors are not adequately educated or they are careless. A systematic method of handling this matter is advised. Division master mechanics should keep a check upon whether or not the work reported by engineers is being done, and see that reports of violations of rules are followed by suitable discipline. Records should be kept of the violations at each terminal and of the employees responsible for them in each case.

ELECTRIC WELDED PATCHES

BY JOSEPH SMITH

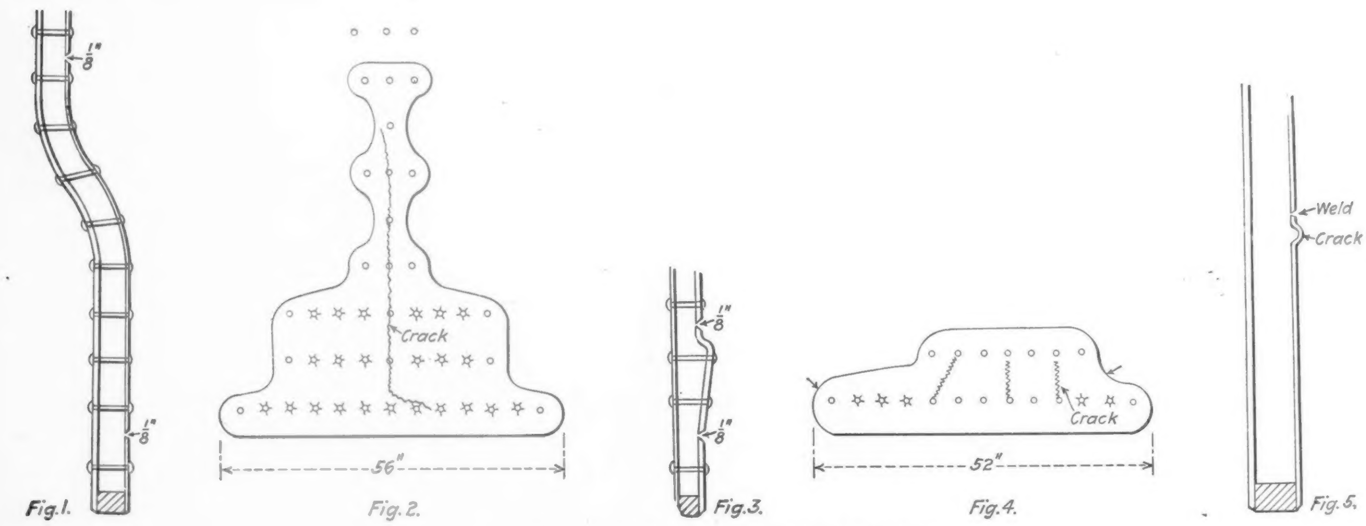
The subject of welding locomotive boilers is one of great importance and various methods of welding patches have been used with success. When patching side sheets the writer has used the electric weld and applied the patches as illustrated.

In the drawing, Fig. 1 shows a patch applied to the right side sheet of a heavy switch engine. The shape of the patch is as shown in Fig. 2 which also shows the crack that had developed in the side sheet.

Figs. 3 and 4 show the shape and application of a patch on the left side sheet of the same engine. This patch was offset $1\frac{1}{4}$ in. at the top and tapered down to the points indicated by the arrows in Fig. 4. This offset has been found preferable to that shown in Fig. 5, which not only gives trouble at the weld, but frequently cracks in the offset.

The stars in Figs. 2 and 4 indicate staybolt holes which were so badly fire cracked that it was necessary to remove that portion of the side sheet.

Both of these patches were fitted in place with the edges of the patches and side sheets beveled to about 30 deg. with $\frac{1}{8}$ in. clearance all around as shown in Figs. 1 and 3. The staybolts were then applied, and the patches electric welded to the side sheets.



Two Electrically Welded Side Sheet Patches

The welding was done by an operator who had had only a few hours' instruction from an experienced welder, and considerable doubt was expressed that this method of patching would prove to be satisfactory. After three months of service, however, there has been no sign of failure or even sweat at the weld.

New

And Improved

Machine Tools

And

Shop Equipment

DUPLEX LOCOMOTIVE ROD BORING MACHINE

A DUPLEX locomotive rod boring machine, which was primarily designed for the boring of locomotive rods, but which may be used for the rapid production of parts which require heavy drilling, such as the reaming of cross-heads, etc., has recently been built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. For work of this kind it is, of course, necessary to provide for a strong and rigid support of the spindles and this is particularly true where full advantage is to be taken of the maximum output with high-speed steel tools. The photographs convey some idea of the massiveness of construction which has been necessary to accomplish this.

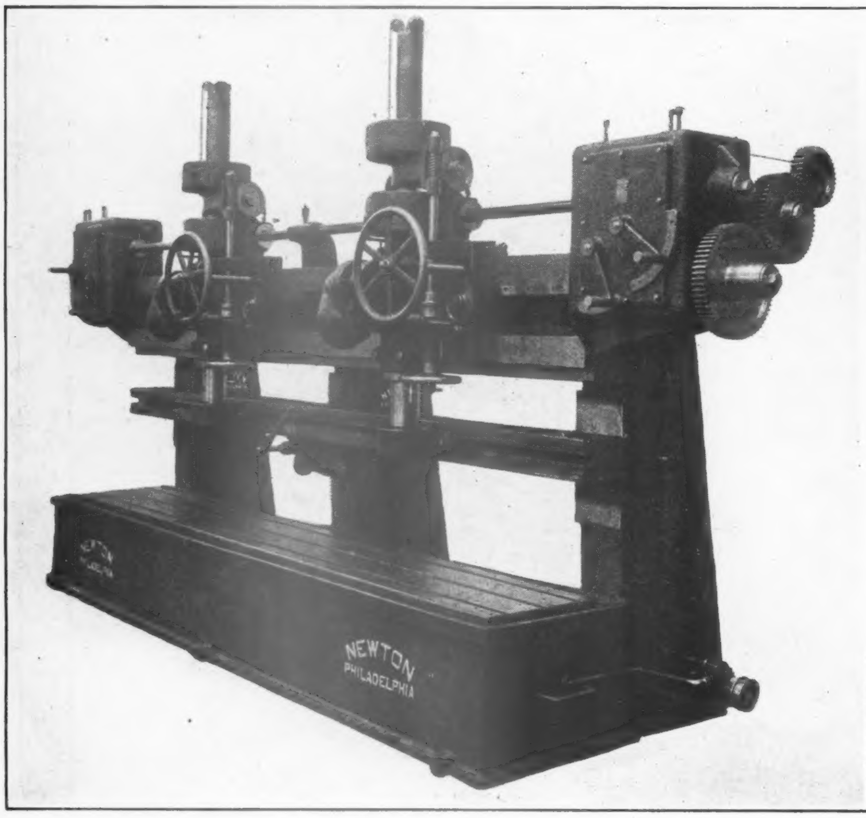
The most novel feature of the new design is the incorporation of the auxiliary side table. This is specially valuable for the reaming of cross-heads. The in-an-out adjustment of this table, supplemented by the longitudinal adjustment of the spindle over the table, permits of clamping the work without having to locate it to the actual center. These adjustments also permit of drilling or boring a series of holes at one setting of the work. The T-slots on the vertical face of the adjustable table permit clamping the work in either a horizontal or vertical position, according to the convenience of the operator. The rail is extended to carry the spindle center 18 in. beyond the vertical face of the auxiliary table, thus giving a maximum distance between the spindles of 14 ft. 5 in. The side table is low to allow work of extra height to be placed under the spindle. For instance, the distance from the top of the side table to the spindle end is 50 in. maximum and 34 in. minimum. This corresponds to a maximum distance from the top of the main table to the end of the spindle of 25½ in.

The machine utilizes cup cutters which dispense with the necessity for drilling pilot holes for the boring bars. The kerf made by the cup cutters in no case exceeds ⅝ in., and the cores are removable solid. The saving in time and power and of wear on the drills is, therefore, an important item. The twin spindles allow a duplication of center distances for similar rods. Two ends of one rod or one end of two rods may be bored at the same time, as may prove most desirable.

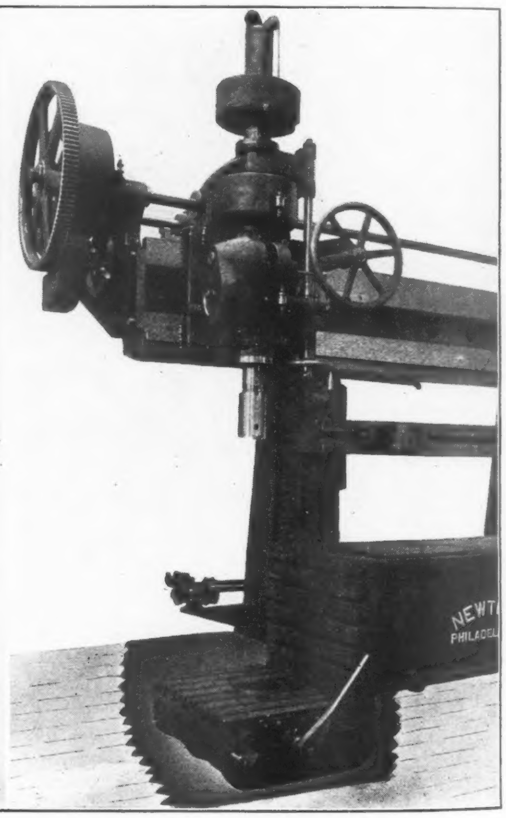
One of the photographs shows quite clearly the arrangement of the side table, while the other one shows the machine without the side table but with speed boxes applied for use with constant speed motors, or for single pulley drives. The changes in speed are made by means of sliding sleeves without the removal of the gears; each spindle is under the control of its own speed box, thus making it possible to suit the speed of each tool to the size of the work.

The top of the massive base is finished and slotted to form a working surface or table. It is surrounded by an oil pan, cast integral with the base. The rail is supported by the three uprights and is of heavy construction, of box type, braced internally by ribs. The spindle saddle has an angular bearing on the bottom section of the rail, insuring close contact under heavy pressure. The top bearing is square, the adjustment being made by a bronze taper shoe on the top and a gib bolted to the saddle on the rear. The saddle may be securely held in any predetermined position on the rail and is adjustable crosswise by means of a pinion, the end of which is squared to fit the removable ratchet.

The spindle revolves in bushed bearings in the sleeve and has a Morse taper, and drift and retaining key slots. The spindles are 4 in. in diameter with a diameter of spindle nose, outside of 5½ in. The minimum distance between spindle centers is 30½ in. The distance from the center of the



Duplex Locomotive Rod Boring Machine With Speed Boxes in Place, But Without Side Table



Showing Application of the Auxiliary or Side Table

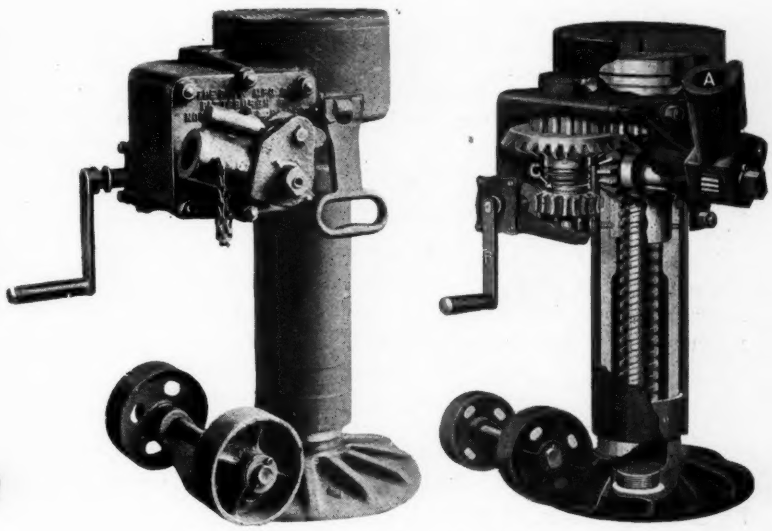
spindles to the uprights is 17½ in. Each spindle is driven by a worm and worm wheel, the worm wheel having a bronze ring with teeth of steep lead; the driving worm is of hardened steel with roller thrust bearings. Both the worm and the worm wheel are encased for continual lubrication. The sections of the spindle fitting in the rack sleeve revolve in bronze bushings. The upper end of the spindle and the rack sleeve are encased and protected from dust and dirt by covers which also serve as a support for the counterweight. Thrust of the worm is taken by a bearing cast solid with the saddle.

Motion for the feed is provided through spiral gears, one of which is mounted on the spindle sleeve; the other is keyed to the horizontal pull pin shank on which are also mounted four pull pin gears, giving four changes of feed which are transmitted to the rack sleeve by means of a worm and worm wheel. A cone friction clutch permits either power or hand elevation. The saddles have hand adjustment on the rail. The auxiliary or lower support for the spindles has a bearing on each upright; it securely supports the spindles at the lowest possible point when cutting, and is raised and lowered by means of a worm and worm wheel. The work table is 24 in. wide and 13 ft. 6 in. long.

HIGH SPEED BALL BEARING SCREW JACKS

An improved type of high speed ball bearing screw jack has recently been designed by the Duff Manufacturing Company, Pittsburgh, Pa. These jacks are specially adapted for the handling of railway equipment and are made in several sizes of three capacities: 35-ton, 50-ton and 75-ton. The high speed feature is obtained through the use of a large pitch, double-thread screw, and safety is insured by a patented automatic, positive safety clutch. The load is raised by placing a long solid steel bar in the lever socket *A* and operating it up and down, the load being raised on each down stroke. The positive clutch *C* holds the load at all times and prevents the possibility of sinking or dropping under the load. A few easy turns of the handle *B* allows the load to be lowered quickly. Regardless of the speed at which the jack may be descending, the lowering handle may be stopped with absolute safety to within a thousandth of an inch of any desired point. So little effort is required to lower the load that a boy can operate the 75-ton jack with ease. By turning the lowering handle in a reverse direction, it is possible quickly to raise the jack up to the load.

External and Sectional Views of 35-Ton and 50-Ton High Speed Jacks



External and Sectional Views of the 75-Ton High Speed Jacks

The thread of the large double screw is so steep that the jack would run down under its own weight were it not for the positive safety clutch. It is, of course, the combination of the steep thread screw and the positive clutch that provides for speed and safety. The screw is made of special steel and turns in a hard bronze nut, having a tensile strength of 90,000 lb. per inch. The combination of bronze and hard steel materially reduces the friction. The base, consisting of the foot and the stem, is made in one piece of cast steel; the shell is of steel tubing; the bonnet and hood of cast steel, and the gears, clutch, shafts, etc., of open hearth machinery steel with the more important parts heat-treated. The pinion shaft is fitted with a heavy phosphor bronze bearing bushing. The ball bearing in the head consists of two chrome nickel steel discs, hardened and containing large hardened alloy steel balls tested to a crushing strain of 110,000 lb. each.

The design and workmanship are such as to reduce the friction to a minimum. To provide for lubrication the inside of each jack is packed with a semi-fluid grease, in which all of the moving parts revolve. The composition of the grease is such that it is not affected by heat or cold and will not leak. Oiling places are provided for the lubrication of every part which requires lubrication and is not reached by the grease.

These jacks may be fitted with foot lifts for the convenient handling of low loads; the toe lift is cast integral with the shell. The 75-ton jacks, which are specially adapted for heavy locomotive work, may be equipped with wheels, as shown in the illustration, to facilitate handling.

The 75-ton jack is made in three sizes as follows:

26 in. high	12 in. lift	weight 360 lb.
24 in. high	10 in. lift	weight 345 lb.
20 in. high	6 in. lift	weight 315 lb.

The 50-ton capacity jack is made in three sizes as follows:

36 in. high	24 in. lift	weight 270 lb.
26 in. high	14 in. lift	weight 235 lb.
24 in. high	12 in. lift	weight 228 lb.

The 35-ton jack is made in two sizes; one 30 in. high, 17 in. lift, weighing 175 lb.; and the other 26 in. high, 13 in. lift, weighing 163 lb.

TWENTY-ONE INCH VERTICAL DRILLING MACHINE

THE vertical drill shown in the illustration is a modification of the standard machine made by the Weigel Machine Tool Company, Peru, Ind. The regular quick return and power feed with back gears have been replaced by a plain quick return operated by four extra levers mounted in the form of a pilot wheel which provides a powerful hand feed. The control lever operating the friction clutch for starting, and acting as a brake for stopping the drill, is conveniently placed for the operator.

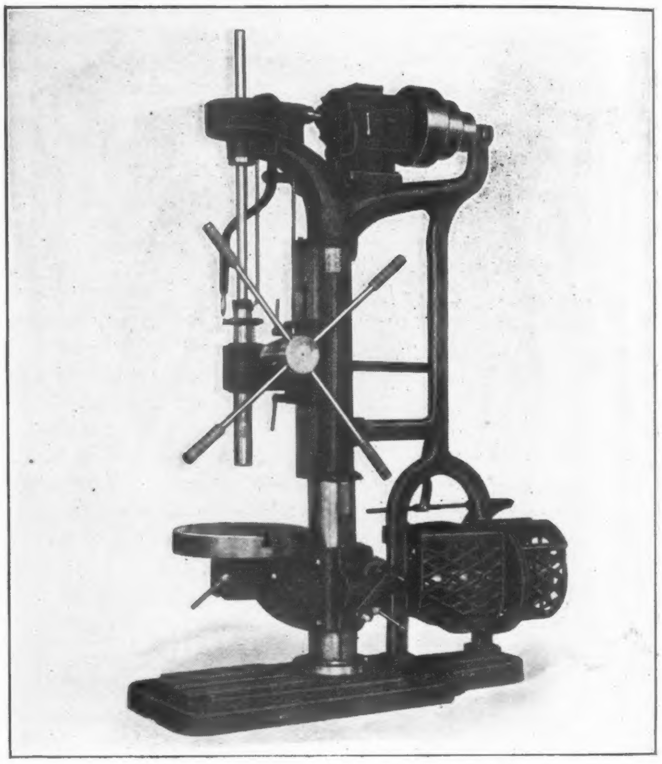
The spindle is driven through a friction type back gear device enclosed in the oil-tight box which is cast as an integral part of the top of the frame. An improved tapping attachment may also be furnished and is placed directly on the spindle.

The standard machine, which is furnished with the friction type back gear contained in a box casting similar to that shown on the top of the frame of the drill illustrated, provides eight feeds for each spindle speed, as indicated by the feed plate attached to the machine, and the same type of lever which is used for starting and stopping the plain hand feed machine is employed on the standard type. A special back gear lever provides means for throwing the gears in and out of mesh. Feeds per revolution of the spindle run from .004 in. to .0432 in., and an automatic stop is provided which can be set to throw out the feed at any predetermined depth.

The plain hand feed machine, as well as the standard power feed machines, are made in 21-in. and 25-in. sizes, and may be arranged for either direct gear motor drive by a 3-hp., 1,500 r.p.m. motor, or for drive by belt. The lower cone pulley is covered by a cast housing and the tight and loose pulleys in the belt drive type have an adjustable cast guard. The mechanical belt shifter, a detail small in itself, contributes to a saving of time.

The base of these machines is heavy and well ribbed underneath. A slot is provided at the front and rear to accommodate a bar for moving and placing the machine when setting it up on a solid floor. The spindle has a 9-in. vertical travel and a No. 4 Morse taper. The column is tubular in section and has an extra large bearing for the table arm, as well as for the sliding head.

The table is 19-in. in diameter and has a traverse of



Vertical Drill With Powerful Hand Feed

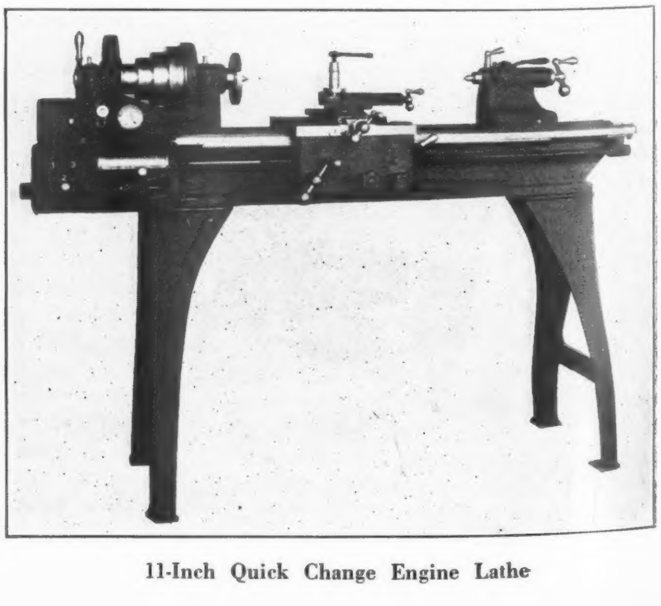
13½ in. on the column. A square table with an oil pan can be furnished instead of the round table. The table is raised and lowered by rack and pinion through a worm gear.

QUICK CHANGE ENGINE LATHE FOR SMALL WORK

THE new 11-in. Star quick change engine lathe in 4, 5, 6 and 7-ft. lengths of beds, has been recently added to the line of tools manufactured by the Seneca Falls Manufacturing Company, Inc., Seneca Falls, N. Y. Because of their wide range for exacting service on light and accurate work they should commend themselves generally to railroad shop tool rooms and testing laboratories.

The smaller size (4 ft.) occupies a space of 27 in. by 64 in.; the largest (7 ft.) requires 27 in. by 100 in. floor space; distances between centers range from 24 in. to 60 in. The actual swing over beds is 12⅛ in. Threads from 6 to 46 per inch may be obtained with a simple, quick change mechanism. By the shifting of a gear on the stud, the range may be increased from 3 to 92 threads per inch, including 11½ per inch, all of which are plainly listed on the index plate on the face of the machine. A special countershaft with three friction pulleys may be furnished to give higher speeds for wood turning.

Details of the construction of these new tool room lathes include a web pattern headstock and a hollow spindle made from carbon crucible steel, accurately ground to size, revolving in ample hand-scraped ring oiling bearings; the nose is threaded part way only to facilitate changing chucks and face plates without damaging the threads and to insure perfect fit. The spindle has a large hole suitable for a draw-in chuck. The cone is locked to the head-gear by an improved



11-Inch Quick Change Engine Lathe

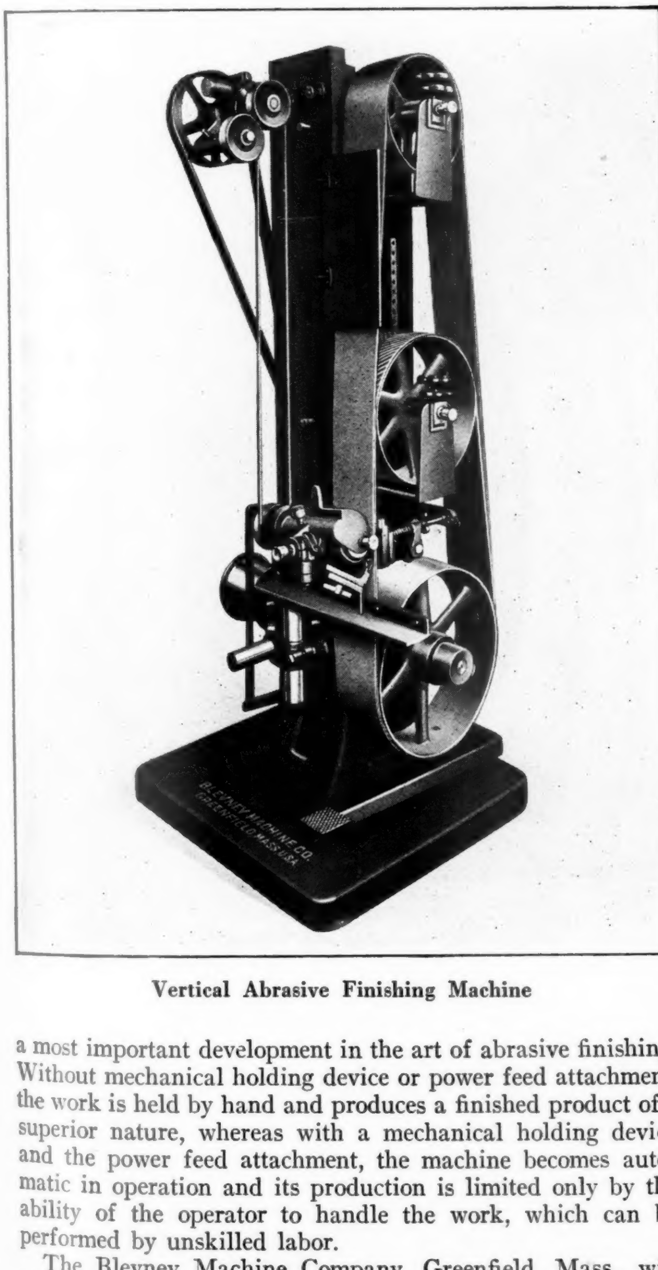
push pin and may be secured or released instantly without using a wrench; all gears are fully guarded. The tailstock has a large spindle with a self-discharging center.

The cross-feed screw on the carriage is supplied with a micrometer collar graduated to read in thousandths of an inch, secured by friction spring and readily set to any position. An adjustable stop for the cross-slide is provided for screw cutting, etc. Feeds may be thrown in or out by turning a hand knob on the apron, which operates a friction clutch. The automatic power cross feed is indispensable for good work; it insures accurate results and smooth surfaces when facing and other similar work. A new safety device is provided in the apron, so that the opposing feeds cannot be engaged at the same time.

The countershaft has two improved clutch pulleys with a large friction surface on the rim of the pulley. Wear on friction parts when the pulley is running idle is eliminated. The net weight of these machines varies from 720 lb. in the 4-ft. model to 985 lb. in the 7-ft. model, complete with countershaft.

AN ADAPTABLE FINISHING AND BUFFING MACHINE

For rapidly polishing and finishing round, flat or curved shapes, grinding flue and tube ends, buffing nickel plated parts, such as car fittings and fixtures, the vertical abrasive finishing machine, embodying a patented two-belt system of finishing, with an abrasive cloth belt running at high speed over a heavy corrugated leather cushion belt, is a most important development in the art of abrasive finishing. Without mechanical holding device or power feed attachment, the work is held by hand and produces a finished product of a superior nature, whereas with a mechanical holding device and the power feed attachment, the machine becomes automatic in operation and its production is limited only by the ability of the operator to handle the work, which can be performed by unskilled labor.



Vertical Abrasive Finishing Machine

The Blevney Machine Company, Greenfield, Mass., will exhibit one of its type A-6-14 machines illustrated herewith, as well as one of its type *F* horizontal finishing machines and a type *A* automatic polishing and finishing machine with power feed attachment, at Atlantic City.

The machine has a heavy cast iron column, providing the necessary rigidity for high speed operation. Steel ways are attached to the column, and the sliding frames in which the idler pulleys operate travel on these ways. The cushion belt is run over the main pulley and the idler next above, traveling at a speed of 7,000 ft. per minute. The cloth abrasive finishing belt is placed over the cushion belt but extends to an idler pulley at the top of the machine. The idler pulley frames in both cases are governed by weighted levers having a fulcrum journaled wheel and steel pinion, forming connection with a steel rack attached to the frame. These weighted levers stand in a horizontal position when the machine is in operation and are governed by a spring which holds the pinions in engagement with the rack. By pulling the fulcrum against the action of this spring the pinion becomes disengaged and the lever may be moved to any desired position, the spring restoring the engagement between the pinion and the rack.

The alinement of the two belts may be controlled by means of the handwheels on the idler pulley boxes, these wheels serving to tilt the pulleys so that the position of the belts may be changed as desired.

A suitable holder or stock rest is provided for holding the stock and for the application of fixtures and attachments. A spring platen or pressure bar is applied back of the cushion and finishing belts, the action of which is controlled by a foot treadle; stops are furnished to limit the forward and return movement of the platen. The face of the platen is made to suit the work to be finished. For plain flat work, the platen has a plain face, whereas, for finishing tubes or round pieces, parallel strips are placed at the top and bottom of the platen, causing the belt to curve around the circumference of the stock being finished. Where desired the platen may be made sectional, or special rotating platens may be furnished with yielding centers.

The productive powers of this machine are made possible through the use of the two-belt system. The corrugated leather cushion belt runs at 7,000 ft. per minute; the cloth abrasive finishing belt which runs over it operates at a slightly increased rate of speed, due to the larger driving member, which is increased in size by twice the thickness of the cushion belt. The increase in speed is slightly more than one inch on each revolution of the main pulley. This creeping is neutralized in operation when the pressure is applied behind the belts, with the result that the travel of the abrasive belt is somewhat retarded at the point of work, so that it must curve into the high and low sections. In this manner high points are obtained for cutting and low points for chip recesses. The corrugations in the leather cushion belt assist in providing chip recesses. After the belt has passed the point where the work is held, it, of course, resumes its normal position and this action throws off or expels.

the chips. A joining machine is used in making the abrasive belts endless; the method employed is such that the thickness is practically no greater at the joint than at any other part of the belt. By this process, not only is a strong belt possible, but one which runs smoothly and evenly and does not jump over the work at the point of joint.

Coarse belts after being first used for roughing, are later dressed down for finishing in various stages until they are finally used as greased belts for the finest finishing.

The cloth abrasive belts do away with centrifugal action upon the finishing grains when they are under strain and provide a uniform speed for each cutting grain. It is claimed that there is practically no loss in abrasive material through the use of the cloth finishing belts.

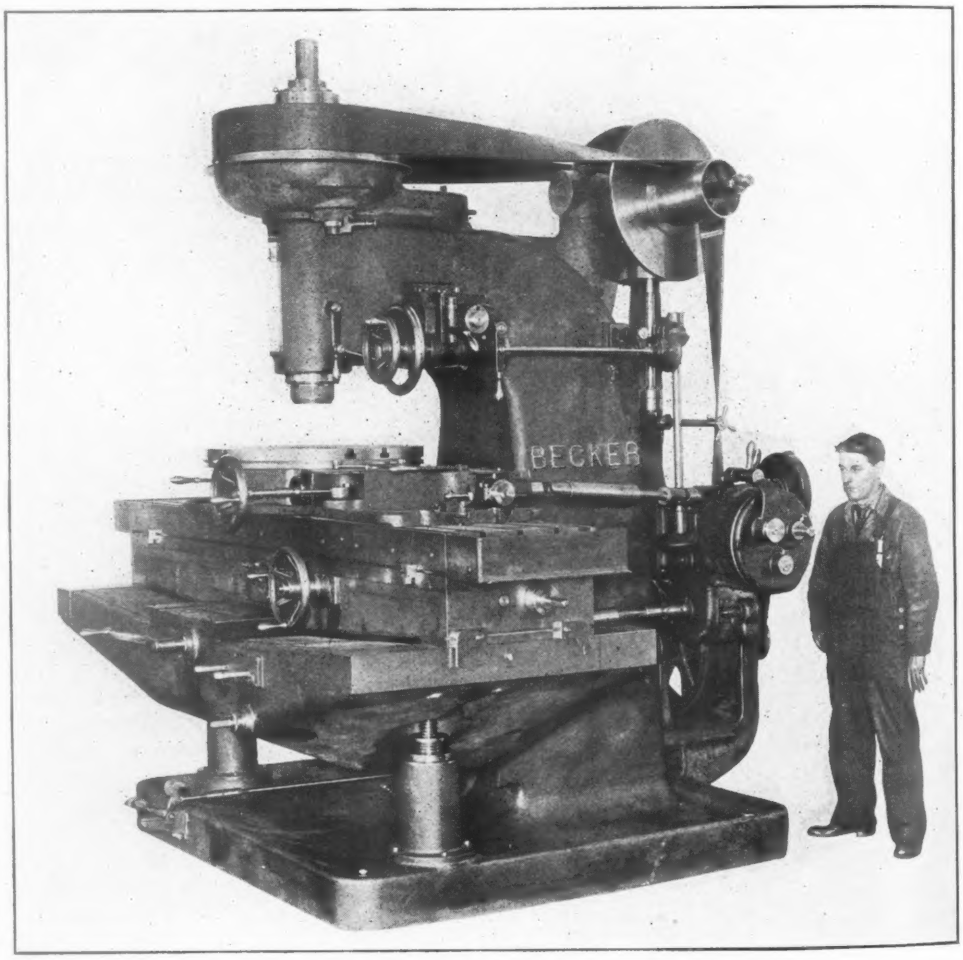
A MONSTER VERTICAL MILLING MACHINE

THE model D-1 vertical milling machine, shown in the illustration, is perhaps the largest machine of this type ever built, and was developed primarily by the Becker Milling Machine Company, Hyde Park, Boston, Mass., for die sinking work in connection with the drop forging industry. When equipped with a rotary table, however, it is specially adapted to heavy milling work. The machine weighs approximately 18,000 lb.; the greatest distance between the spindle and the main table is 22 in., and between the spindle and the rotary table 13 in. The greatest distance from the center of the spindle to the frame is 25½ in. Aside from its large size, however, the machine includes several important and interesting features.

It was necessary to make the movable knee (96 in. long) of specially heavy design; it is supported by telescopic screws at each end and on the frame by the Becker patent gib. The screws are accurately co-ordinated so that they work in perfect unison. The knee is elevated and depressed by a single control wheel when operated by hand, but this operation may be performed by power by simply throwing in a clutch. The knee has a vertical feed of 20 in. The saddle, of rigid construction, has three bearing points on the knee. It is of extra length (96 in.) and supports the movable table throughout its entire length.

All of the control levers are centrally located so that the operator can watch the work and control the machine without undue exertion. The table is provided with power rapid traverse in either direction and a fine hand adjustment from the operator's position in front of the knee or at either end of the table. Hand adjustment for the cross and vertical feeds is provided for at the center of the knee. The table has a working surface 20 in. wide and 96 in. long with an over-all working surface 110 in. long. It has a longitudinal feed of 79 in. and a cross feed of 20 in. There are three T-slots ¾ in. wide; also oil grooves on the sides of the table with an oil pan at each end for collecting the lubricant. Micrometer dials are provided on the transverse and longitudinal feeds and the Becker micrometer stop gage in the spindle head provides for operations requiring decimal accuracy.

The spindle is of the Becker-Barrell type construction and is provided in addition to the above-mentioned micrometer stop gage with an adjustable automatic stop, and a fine hand adjustment and quick return mechanism. The spindle has a vertical power feed of 13 in. and is back geared and driven by a 6-in. double belt in order to insure smooth action and the elimination of chatter. It has a main bearing 4 in. in diameter and 9⅞ in. long. The feed per revolution of the spindle with open belt is .003 in. to .09 in., and with back gears .013 in. to .46 in. Three changes of feed are obtainable by means of gearing in the feed box, but a wide range of feeds of any desired amount within the above limits may be obtained by the Becker patent friction feed.



Becker Standard Model D-1 Vertical Milling Machine.

When belt driven the machine is provided with a single pulley drive having a gear box with seven changes of speed, thus giving the spindle 14 speeds, ranging from 45 to 260 r. p. m. with the open belt, to 9 to 51 r. p. m. with the back gears. The machine may, however, be arranged for a 10 h. p., 850 r. p. m. motor, or for a motor having a speed range with a ratio of 4 to 1, in which case the speed box is not necessary.

PORTABLE QUICK-ACTING HAND PUNCH

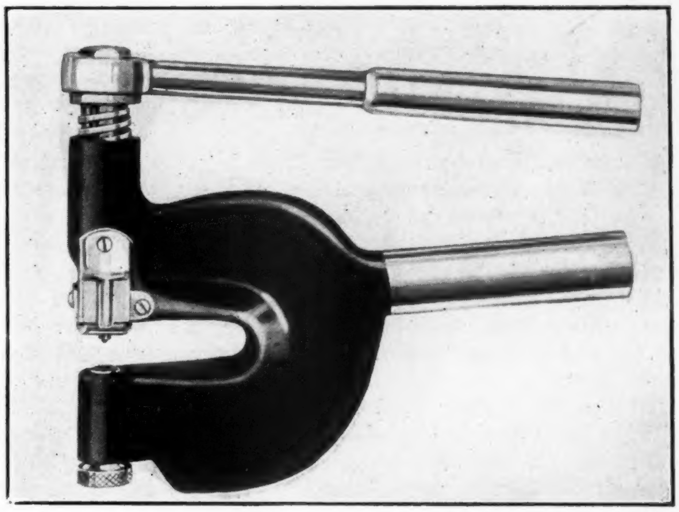
A PORTABLE and compact punch, which at the same time is powerful and quick-acting, has recently been placed on the market by Paul W. Koch & Company, Chicago, and is known as the "Jiffy" punch. It weighs five pounds, is 9½ in. long, will work in a small space, and punches holes up to ¼ in. in metal as heavy as 10 gage. Very little oiling is required and no adjusting.

As may be seen from the illustration, the throat is deep and this, with the one-piece, automatic, disappearing stripper, gives a clear view of the punch and punch mark for the next operation. Several sheets may be punched with one operation.

The crowned punches of the floating type direct the power to the center and will not twist or turn during the operation, thus reducing the possibility of punch breakage. These punches do not leave a burr on the metal.

Several features contribute to the convenience of the operator. Among these is the absence of long, clumsy handles; the operator is brought close to the material and can follow the punch marks quickly and accurately; only a half turn of the lever is required to drive the punch through the metal; the handle is above the center and naturally tends to keep the punch upright.

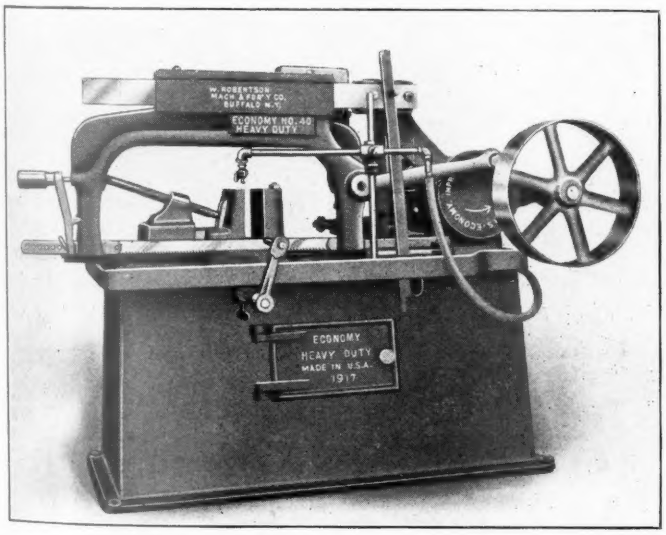
The punches and dies may be changed easily. There may be some classes of work with which it is desirable to clamp the punch in a vise; this can readily be done with the Jiffy punch.



"Jiffy" Portable Speed Punch

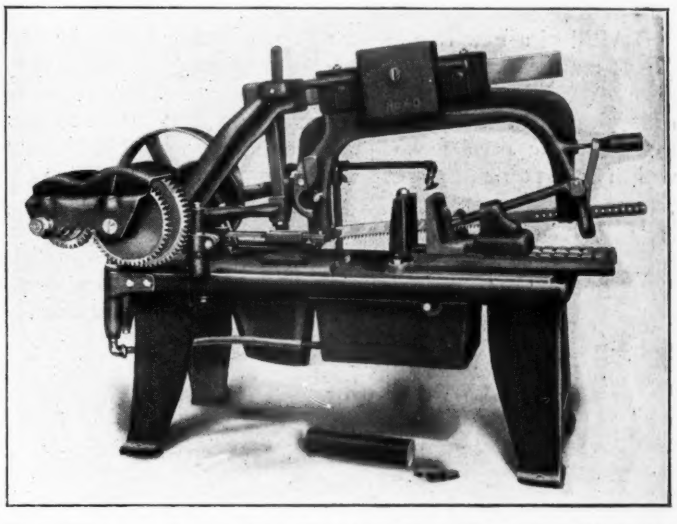
A POWER METAL SAW WITH TWO SPEEDS

A HIGH speed power metal saw arranged to provide two speeds is being built by the W. Robertson Machine & Foundry Company, Buffalo, N. Y. The latest model, known as Economy No. 40, has a capacity for cutting material up to 8 in. by 8 in. in section. The two speeds make it possible to use the proper speed for either hard or soft metals. The arrangement for changing speeds is simple. Two pinions—24 and 32 teeth—are mounted on the back or driving shaft; they mesh with gears on the crank shaft having 58 and 50 teeth respectively. There is a hardened steel clutch between the pinions on the back shaft, which can be made to engage with either one of the pinions or take a neutral or central position, leaving the machine idle. The clutch is operated by the knob at the end of the drive shaft. The machine stops automatically when the cut is completed.



Front View of Power Saw With Box Base

These saws are arranged to cut on the draw stroke and lift on the idle or return stroke, thus relieving the teeth of all drag. This is controlled by what is known as an oil lift which consists of a two-cylinder pump submerged in a tank of oil. One piston is connected with the frame which carries the saw and the other with the crank shaft. At the end of the cutting stroke, oil is forced under the piston connected to the frame, lifting it, and at the beginning of the cutting stroke the pressure is released as the piston passes a small port, a 1 in. steel ball acting as a valve; there are no delicate or complicated parts in this mechanism. It is impossible for the frame to fall and break blades while the work is being adjusted.



Rear View of Power Saw Showing Back Gears for Obtaining Two Speeds

The cutting lubricant is supplied from a tank in the base of the machine by means of a plunger pump, the oil draining

back into the tank. The vise is quick-acting and swivels to 45 deg. for cutting angles. Saw blades from 12 in. to 17 in. are used, No. 18 gage being recommended. A modification of this design, known as the 40B, is fitted with a box base forming a larger receptacle for the cutting compound. A machine of this latter design weighs 600 lb.

AUXILIARY HOIST FOR TRAVELING CRANES

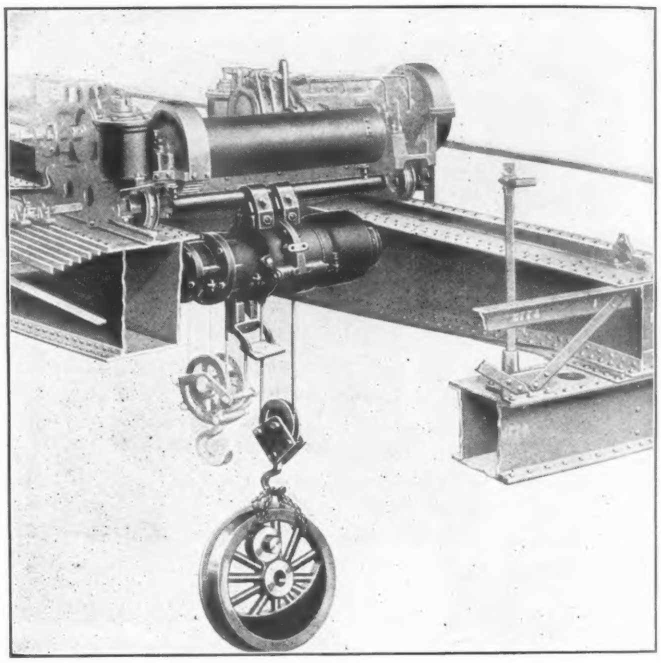
A SIMPLE and practical auxiliary hoist for attaching to any standard overhead electric traveling crane, has recently been developed by N. B. Payne & Company, 25 Church street, New York.

This hoist can be quickly and easily attached, it does not take up any additional room overhead, does not require an extra trolley, does not shorten the travel of the trolley on the bridge and does not interfere with the accessibility of the main hoist.

The average traveling crane handles a far greater number of light loads than heavy loads. As cranes for lifting heavy loads are slow moving, their use results in a serious loss of time if they handle the light loads. Thus a 20-ton crane with a hoisting speed of 12 ft. per minute will handle a three-ton load at but slightly greater speed, but with the auxiliary hoist a load of three tons may be handled at a speed two to 10 times higher than the speed of the main crane.

This auxiliary also effects an important power saving. Very often the hook and block of the main crane together weigh more than the load handled, and as the auxiliary hook and block are much lighter it is evident that the power saving is appreciable. The labor saving with the auxiliary hoist is another item worthy of consideration, especially when a gang of men must wait to have a small piece slowly moved by a large crane.

By the application of this auxiliary attachment any standard single hoist electric traveling crane may be equipped with two lines for drop bucket service. The control may be arranged from cage, floor or pulpit to suit the crane to which it is applied.



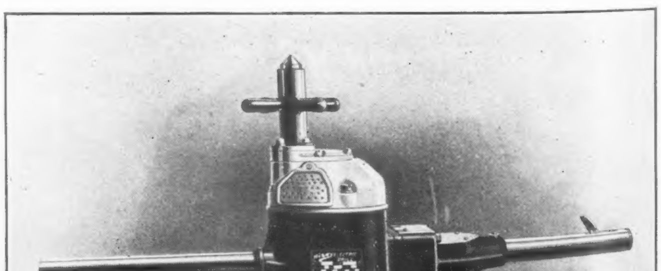
Application of Auxiliary Hoist to Traveling Crane

Usually standard auxiliary hoists of from one to five tons capacity, suitable for the type of crane, electrical equipment and type of control, are supplied by the makers to meet ordinary requirements, but larger special sizes are furnished when specified.

ELECTRICAL DRILLING AND REAMING MACHINES

PART of a new line of heavy duty electrical drilling and reaming machines has been completed by the Hisey-Wolf Machine Company, Cincinnati, Ohio. Typical examples of this line are shown in the illustrations. In order to secure the necessary capacity and yet keep the weight within reasonable limits, it has been necessary to use the very best materials and go to the greatest refinements in design. The motor is, of course, the critical part of the machine and special attention has been given to forced ventilation in order to keep the temperature as low as possible; this is accomplished by means of a fan attached to the armature shaft. The machines may be provided with either direct current or

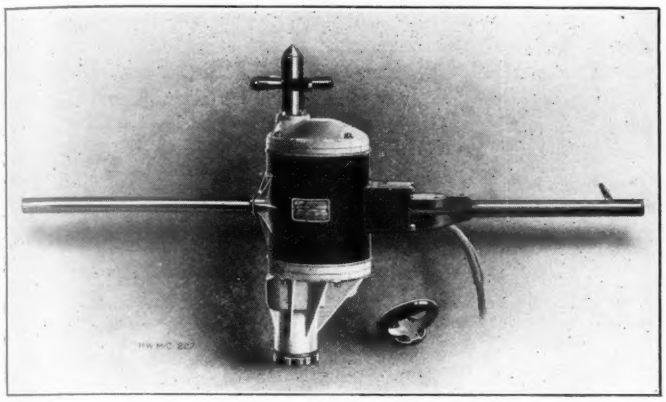
¾-Inch and 1-Inch Electric Drill



1¼-Inch Machine With No. 3 Morse Taper Socket

alternating current motors. The larger sizes are equipped with automatic switches, the instantaneous and positive ac-
contacts.
tion of which practically eliminates arcing and fusing of

The main spindle bearing is made of bronze and is large enough to withstand the effect of the irregular drilling pres-



1¾-Inch Machine With No. 4 Morse Taper Socket

sures. Ball bearings are used wherever applicable; all the bearings are completely enclosed and wherever necessary felt protector washers are supplied. The bearings, gears and other moving parts in the gear end of the motor are supplied with a lubricant from the gear transmission case. The ball bearing on the commutator end is packed with grease.

The side handle, opposite the switch handle, is removable in order to adapt the machines for close corner drilling. In some cases, it is necessary to have perfectly balanced machines, and two sizes of heavy duty drills have been designed with a center spindle drive, the drill spindle being in line with the center of the main body. One of these sizes has a capacity for drilling ¾ in. or reaming 9/16 in. holes in metal, or drilling 1½ in. in wood; the other size has a capacity for drilling 1 in. or reaming 11/16 in. in metal or drilling 2 in. in wood.

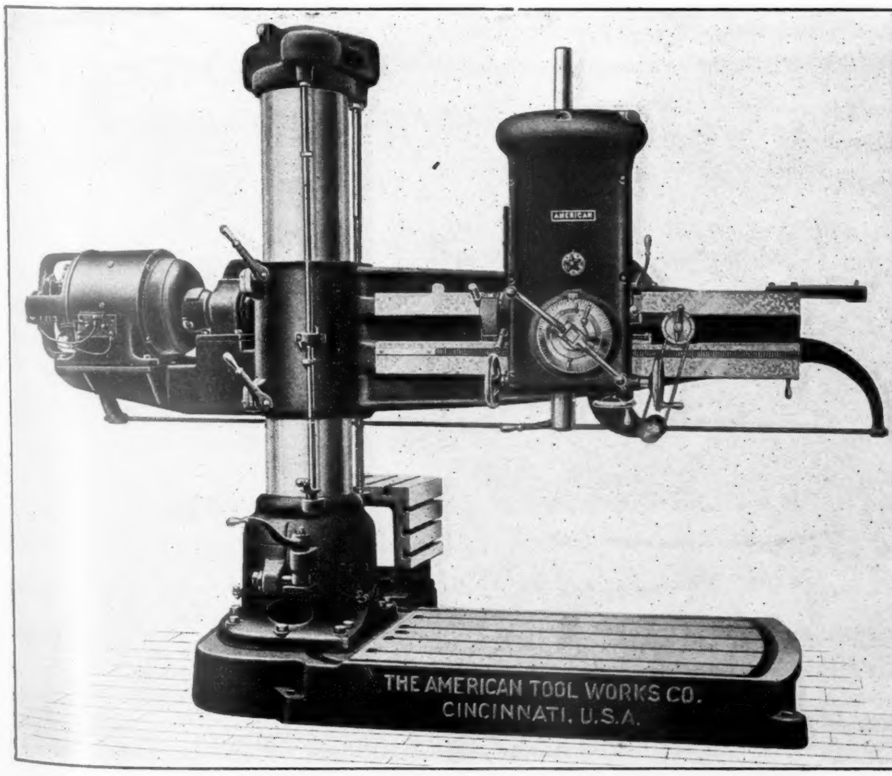
Certain of the machines are designed for two speeds, the change in speed being made by a gear shifting device operated by a thumb nut on the outside of the gear end cap. This insures positive engagement of the gears but speeds may be changed while the machine is in operation.

These drilling machines are not regularly furnished with a breast plate because there is seldom need for this attachment on the larger portable machines; it may, however, be furnished, if desired. The electrical connections are made by means of spring contacts wherever practicable. Provision is also made for renewing the attaching cable without disturbing other parts of the machine.

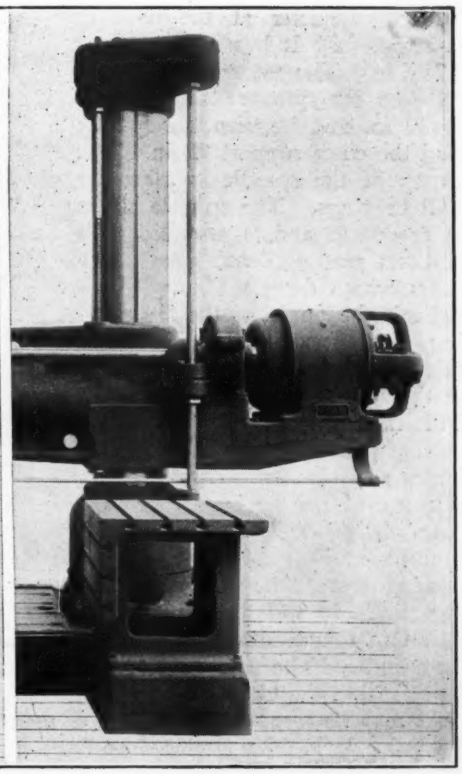
The heavy duty alternating current machines are now available for drilling metal in the following capacities: ¾ in., 1 in., 1¼ in. and 1¾ in. The direct current machines are made for drilling 1¼ in. in metal or 3 in. in wood. Other sizes up to a capacity for drilling 2 in. in metal are expected to be ready shortly.

SIMPLIFIED MOTOR DRIVE FOR RADIAL DRILL

The problem of applying power for driving radial drills has always been a difficult one and it was not simplified by the introduction of the individual motor for driving machine tools. Many of the earlier applications, for instance, required two motors—one for driving the machine, and the other for elevating and lowering the arm. Improvements in the motor drive have, however, been made steadily in recent years and a radical change has now been brought about by the American Tool Works Company, Cincinnati, Ohio, in the application of what it designates as a "Simplified



Simplified Motor Drive for 6-Ft. Triple Purpose Radial Drill



Rear View of Motor and Column

motor drive" to its "triple purpose" radial drills. As shown in the illustrations, the motor is mounted on the arm in such a way as to partially balance the weight of the working portion of the arm and the head; incidentally, this relieves the cramping tendency on the column sleeve, facilitating the swinging of the arm.

The principal advantages of the new application, however, are in the elimination of a number of bevel gears, spur gears and long shafts which are required when the motor is mounted at the base of the machine. It is estimated that 50 per cent of the gear friction in the drive is thus eliminated and that there is a corresponding decrease in the bearing friction. As a result the cost of maintenance should be very considerably reduced, as well as the amount of power required to operate the machine. Taking the motor off of the floor, away from the dust and dirt, is another desirable feature, not alone from the reduction in wear and tear on the motor, but also from the fact that the space formerly occupied by the motor can be utilized for working purposes. The problem of oiling the machine is simplified because of the smaller number of bearings. The control for the electrical equipment is mounted on the head of the drill making it possible for the operator to start and stop the motor at will and vary the spindle speeds without changing from his working position.

Four mechanical speed changes to the spindle are provided in the head but this is not sufficient where it is desired to handle a variety of work and it is, therefore, necessary to provide a variable speed motor. This limits the application to places where it is possible to secure direct current for the drive. A semi-enclosed 3 to 1, approximately 400 to 1200 r. p. m., direct current motor and a drum type, non-reversing, variable speed controller, of the smallest frame obtainable, are recommended by the makers of the machine. The 6-ft. "triple purpose" radial drill which is shown in the illustration was described in the *Railway Mechanical Engineer* of May, 1917, page 271.

HORIZONTAL BORING AND DRILLING MACHINE

A HORIZONTAL boring and drilling machine, adapted for drilling, boring, facing and tapping has recently been developed by the Morris Machine Tool Company, Cincinnati, Ohio. It is simple in construction and so arranged that all of the control levers are within each reach of the operator. The head, of heavy construction, is counterbalanced and slides on wide ways fitted with taper gibs which are adjustable for wear. The head may be raised and lowered by means of the hand wheel at the top of the column. A steel scale is set in the column and is graduated in sixteenths of an inch; this, in connection with the micrometer collar on the elevating screw, enables readings to be made in thousandths of an inch for the full travel of the head.

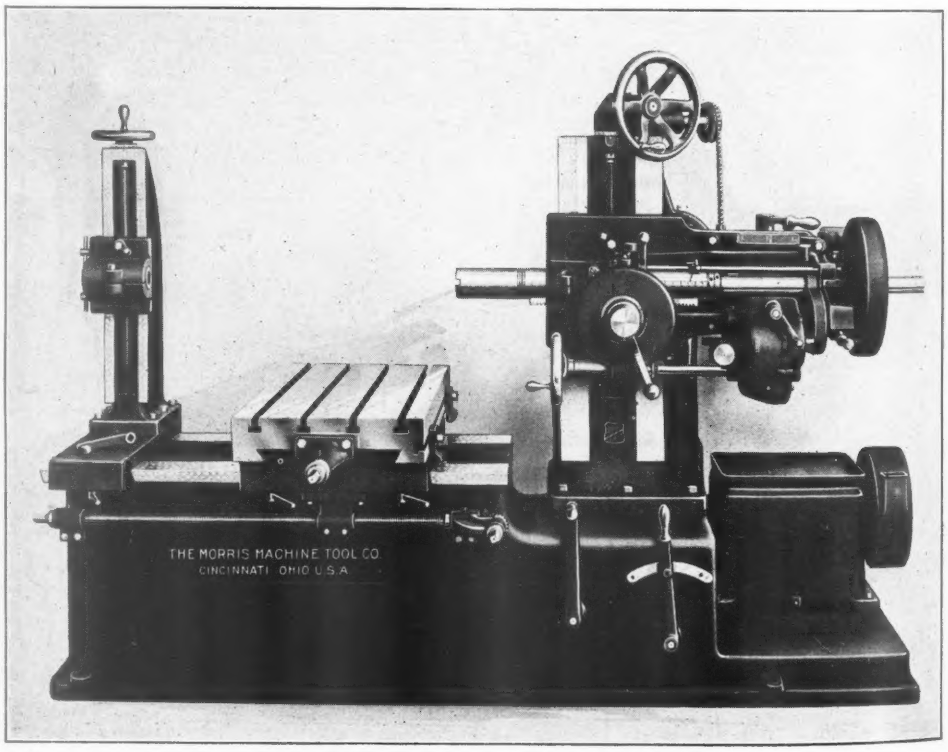
The spindle is 1-15/16 in. in diameter at the smallest section with a diameter at the nose of 3-11/32 in. It has a traverse of 17¼ in. The maximum distance between the spindle and the table is 20 in. and between the spindle and the outer support 48 in. The thrust of the spindle is taken by ball bearings. The spindle sleeve is graduated and is provided with a direct reading depth gage. The gears which drive the spindle are helical, the angle of the teeth being just great enough to have more than one tooth in mesh and at the same time avoid end thrust. This insures uniform power at the cutting point of the tool and eliminates any chatter. The feed box is mounted on the head, the feed gears being fully enclosed and running in heavy oil. Six feeds, ranging from .006 in. to .03 in., are available and are marked on a dial in thousandths of an inch advance per revolution of the spindle. The feed may be automatically tripped at any depth within the traverse of the spindle.

As may be seen, the speed box is mounted on the end of the bed. It is fully enclosed and the gears run in a light grease. The two vertical levers at the front of the bed directly below the column control the six speeds provided by the speed box. The left-hand lever controls the double friction clutch on the pulley shaft and the right-hand lever three sliding gears. There are 18 spindle speeds in all.

The back gears are made of 3½ per cent nickel steel, are fully enclosed and are mounted on the back of the head. The bearings throughout are of bronze arranged with oil chambers, the oil being drawn into the bearings by felt wipers.

The table has a surface of 20 in. by 36 in., a longitudinal movement of 31 in. and a cross movement of 28¾ in. The top of the table is 31 in. above the floor. The bed is a one-piece box section heavily ribbed; the column is also of box section with as large an area as possible where it rests on the bed.

The machine may be arranged for either a 3 to 1 variable speed motor, connected to the lower shaft by a single pair of gears, or for a 5 h. p., 1200 r.p.m. constant speed motor.

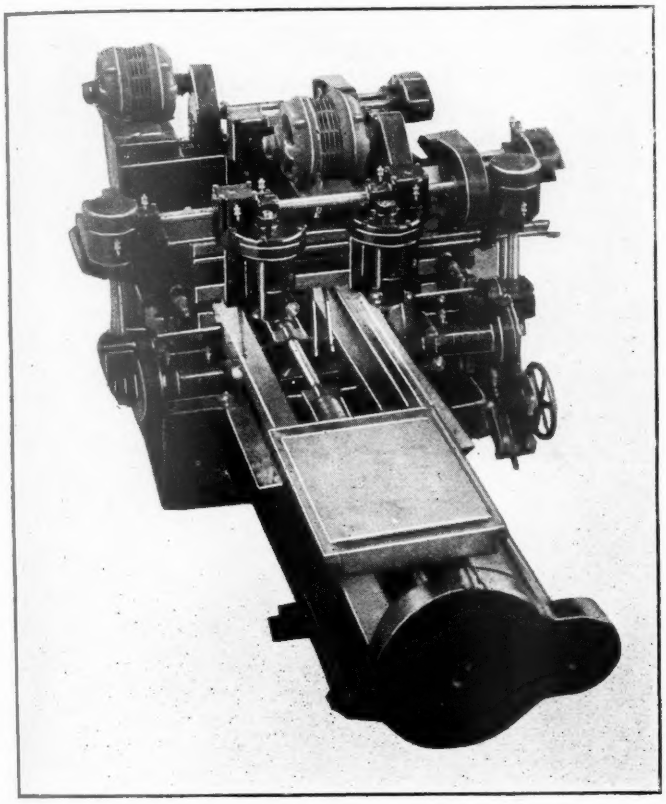


Morris Horizontal Boring and Drilling Machine

HEAVY HORIZONTAL CONTINUOUS MILLING MACHINE

The elimination of all possible lost motion and unproductive time in operation is the keynote in the design of the horizontal multiple unit milling machine shown in the illustrations which records a notable advance in the development of this type of machine tool.

Each pair of uprights with its bank of spindles constitutes one milling unit; as many spindles may be mounted on a unit as is considered necessary, and as many units may be attached to the bed as are required to do the work, although two, as shown in the illustrations, are usually considered sufficient. The feed driving mechanism is carried on one unit only.



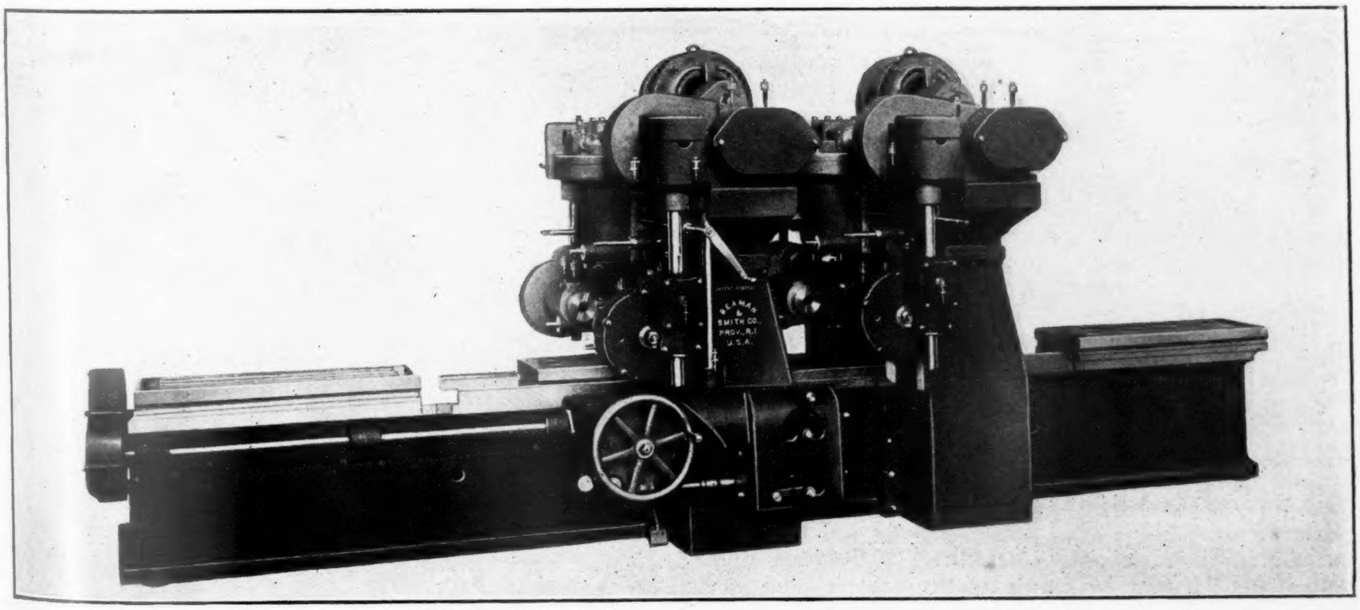
Looking Down Upon Continuous Milling Machine

Removable tables, carrying the work, feed continuously along the bed, taking a fast motion when the cutters are idle and a slow motion when the cutters are working. After passing all of the cutters, the tables are lifted from the bed and the finished work removed. Another table with the work already attached, is placed on the front end of the machine and the process is repeated; as many tables are furnished as are necessary to maintain continuous milling. Such machines will handle on one trip of each table, any milling required on two sides and the top of any piece within its capacity, and by loading the tables to capacity, a large amount of work may be handled in a comparatively short time. The machine once started need not be stopped until it is desired to change the cutters or to accommodate new work.

The bed ways on which the tables travel are flat, with slight tapers on the inside edges to accommodate corresponding tapers on the bottoms of the tables. These center the tables without wedging them and allow them to be put on and taken off rapidly. The tables hold themselves in position by gravity while traveling, except while passing by the cutters, where they pass under gibs, fastened to the bed, which hold them against all vertical movement while the cuts are being taken. A feature of the table design is the narrow guide which is tapered; this makes for the maintenance of a greater degree of accuracy through a longer period than the common wide guide; there is a taper gib to take up the wear.

A feed shaft, which runs the entire length of the bed and is driven from the front end, carries a series of worms which engage in a rack on the bottoms of the tables and are spaced at such intervals that the traveling tables are picked up by one worm before they have completely left the other. The spacing of the worms makes it impossible to set a table in the wrong position on the bed, so that no matter where it is set, it will pick up and travel instantly. The tables have feed in one direction and fast motion controlled by hand in both forward and reverse.

There are four changes of feed through the gearing, providing a variation of from approximately 3 in. to 8 in. a minute, with a fast motion of about 12 ft. a minute when the cutters are idle. Two changes of feed are possible through



Continuous Milling Machine

change gears at the end of the gear box and two more are possible through a feed gear shifting lever. The feed and fast motion are controlled by one lever which makes it impossible to throw in both at the same time. The object of the feed gear shifting lever is to slow down the feed as occasion may require. The feed mechanism is driven by means of a vertical shaft connected through bevel and reducing gears to the main drive shaft.

Each unit is motor driven. The motor and driving mechanism are carried on the crossrail, and the drive shaft is geared direct to the motor which, through reducing gears, drives the vertical and horizontal spindles. Through change gears which are easily accessible the spindles can be given various speeds.

The heads are of rigid construction, cast in one piece, and are adjustable along the ways by means of hand operated screws; the wear may be taken up by taper gibs. When a cutter is located the head is clamped firmly in position.

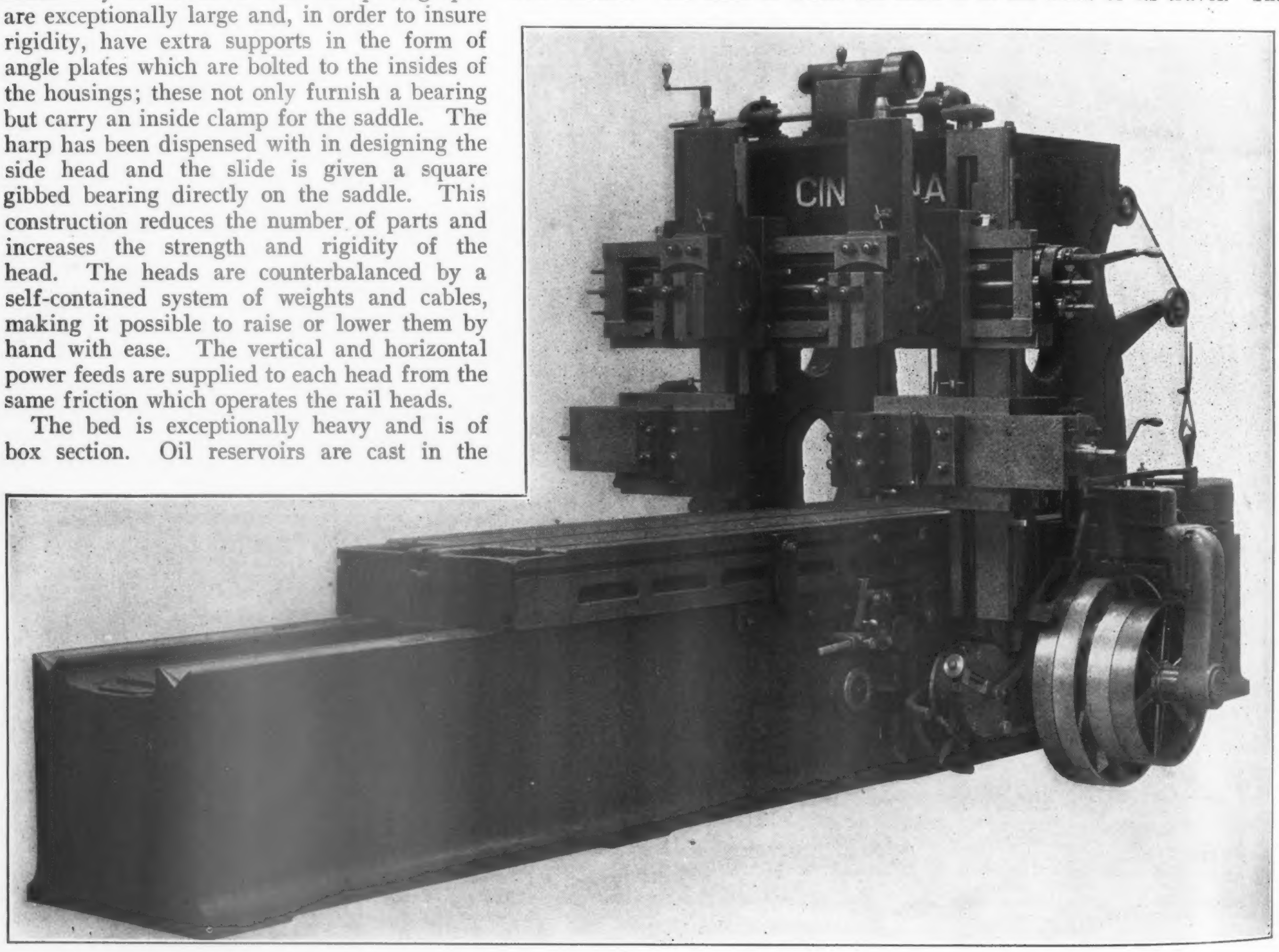
Spindles are furnished in three standard sizes, the largest diameter in the front bearings being 3⅝ in., 4⅝ in. and 5⅝ in. All sizes may be incorporated on one machine and in heads located as the occasion requires; they are furnished with adjustment in and out of the heads, by pinion and rack. The pinion is held in the head and the rack is on the spindle quill. The quill is held in its final position by being clamped and the machine is controlled at the unit which carries the feed gears. One of the illustrations gives an idea of the relative proportions and arrangements of the machine from the starting end and shows a work table in position for feeding toward the first unit.

These continuous milling machines are manufactured by the Beaman & Smith Company of Providence, R. I.

EXTRA HEAVY DUTY OR SPECIAL FORGE PLANER

WHAT is known as a 30-in. Cincinnati special forge planer has recently been built by the Cincinnati Planer Company, Cincinnati, Ohio, for extra heavy work. Special attention was given to the design of the side heads; some idea of the substantial construction of these heads may be obtained from the photograph. The saddles are exceptionally large and, in order to insure rigidity, have extra supports in the form of angle plates which are bolted to the insides of the housings; these not only furnish a bearing but carry an inside clamp for the saddle. The harp has been dispensed with in designing the side head and the slide is given a square gibbed bearing directly on the saddle. This construction reduces the number of parts and increases the strength and rigidity of the head. The heads are counterbalanced by a self-contained system of weights and cables, making it possible to raise or lower them by hand with ease. The vertical and horizontal power feeds are supplied to each head from the same friction which operates the rail heads.

The bed is exceptionally heavy and is of box section. Oil reservoirs are cast in the girths at each end in order to catch all of the used oil and hold it until it may be drawn off through the plug in the end of the bed. The improved box type table is specially heavy and of unusual depth. The bottom side is entirely closed; chips cannot, therefore, drop through the table but are collected on the inside and may be removed through the cored holds at the sides. Heavy ribs at short intervals tie the top and bottom of the table securely together, thus preventing any possibility of springing either when clamping the work on the table or while the table is at the limit of its travel. The table is also gibbed to the bed to prevent any tendency to raise as the tools enter a heavy cut.



Thirty-Inch Cincinnati Special Forge Planer

The housings are of box type and in addition to being keyed are securely bolted and pinned to the bed. They are

tied together at the top by a heavy arch, thus insuring rigidity when the rail is in its highest position. As may be seen, the rail is quite deep and has an extra deep box brace on the back to provide additional stiffness. The two heads are right and left hand and can therefore be run very close together. The slides are of extra length and have a full bearing on the harp at all times. The heads are equipped throughout with taper gibs to compensate for wear. It has also been necessary to provide special tool blocks of heavy design which are so arranged that the tool will be held in a perpendicular position.

The side heads may be run down completely out of the way of the rail heads. The planer is arranged for a motor drive from the top of the housings but it can be modified to suit any other type of drive. Steel gearing and racks are used throughout. The driving gears are of chrome nickel steel; all high speed bearings are of bronze.

VALVELESS AIR DRILL AND NEW CHIPPING HAMMER

PROBABLY no tools used in a railroad repair shop require more ingenuity in design and more accuracy in workmanship than do the air operated drills and hammers. Two new tools have recently been placed on the market by the Keller Pneumatic Tool Company, Grand Haven, Mich., which possess novel features. The one containing the most radical improvements is a valveless drill.

Valveless Air Drill

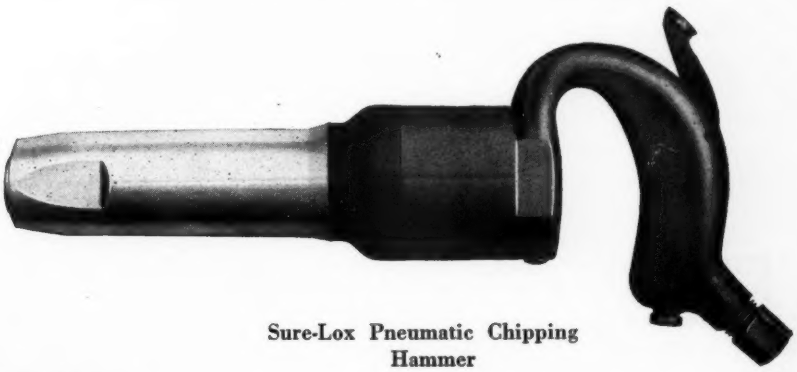
Because of the elimination of the delicate valve mechanism it has been possible to make an air drill which is exceptionally light and compact. It is claimed that it will stand up under the most severe service and that it is exceptionally

Keller Master Valveless Air Drill

economical in air consumption. These features should, of course, be reflected in the cost of maintenance and the amount of time that the drills will be out of service for repairs.

Four single-acting pistons are arranged in pairs at right angles, each pair connected to opposite wrists of the crank shaft. This is said to insure smooth running and freedom from vibration. The one-piece cylinder body is provided with handhole openings which are covered with removable plates, affording ready access to the crank connections. The connecting rods and pistons are made of vanadium steel; the rods are fastened to the pistons by ball and socket joints secured by ingenious locking devices which permit replacement of either the connecting rod or the piston. The crank shaft is a drop forging, hardened and micro-ground, and is amply large to prevent springing. It is mounted on liberal size annular ball bearings, thus insuring a minimum amount of friction and wear. The connecting rods are attached to the cranks by means of toggle joints secured with lock nuts; these also serve to stiffen the rods.

The main gear is cut from a solid blank of high-grade steel and is enclosed in a separate case which is filled with grease, thus insuring independent and continual lubrication. The spindle bearing is extra long with an additional



Sure-Lox Pneumatic Chipping Hammer

bearing where it joins the crank shaft, thus protecting the spindle and the casing from heavy stresses when used on severe work or when the drill is used in a horizontal position. These drills are built in non-reversible or reversible types, including a reversible wood boring machine and a reversible grinder.

Sure-Lox Pneumatic Chipping Hammer

The new type of pneumatic chipping hammer, known as the Sure-Lox, is so named because of the peculiar manner of locking the handle to the cylinder. This eliminates the old-style clamp-bolt which was often objectionable, particularly for work in close quarters. The new handle is locked directly to the cylinder in a positive and rigid manner by means of a key which is inserted in the cylinder and engages one of a series of slots in the handle. The key is securely held in place and the entire lock arrangement is covered by a neat spring clip. All projections or obstructions which might interfere with the convenient handling of the tool are eliminated.

Another novel feature of this hammer is the extra long striking end on the piston. This is 5/8 in. instead of 3/16 in. as commonly used. The retaining wall in the cylinder is also correspondingly strengthened, adding to the durability and adaptability of the hammer. The moving parts are all hardened, ground and lapped to size. The parts are absolutely interchangeable. The hammers may be furnished with either open or closed handles in 10 sizes, ranging from 1¼-in. to a 4-in. stroke.

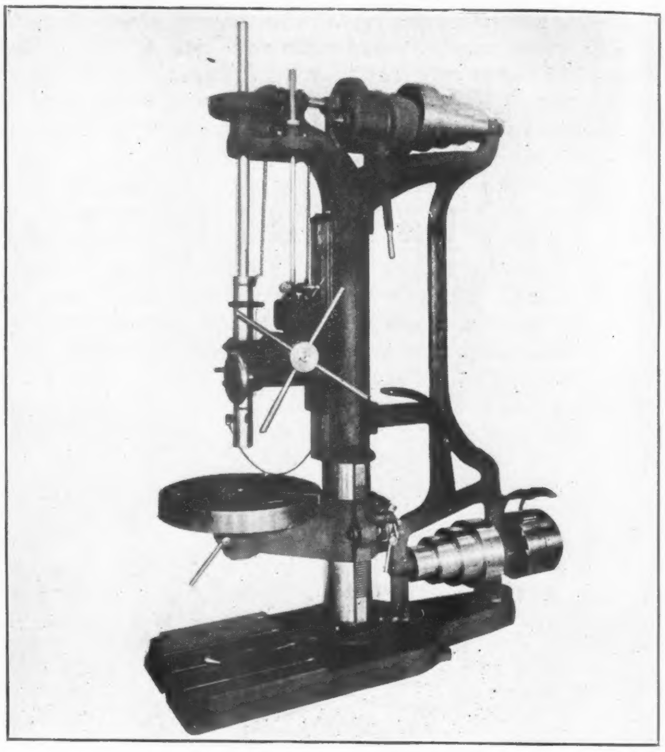
UPRIGHT DRILLS COMPLY WITH STATE LAWS

THE Aurora Tool Works, Aurora, Ind., has recently improved its 28-in., 32-in. and 36-in. sliding head drills by the doing away with the so-called gear covers and thoroughly enclosing the gears to have them comply with the various state laws. Incidentally this has added greatly to the appearance of the machines, as is indicated by the illustration.

These drills are designed for heavy duty. The column, spindle, sleeve and all shafts are ground. The spindle is provided with a ball thrust bearing and is driven by bevel gears having a ratio of 3 to 1. The maximum distance from the spindle to the base on the 28 in. machine is 50 in., while the maximum distance from the spindle to the table is 36 in.; the machine will drill to the center of 28½ in.

The spindle has a diameter of 1-11/16 in. above the sleeve, and has a traverse of 12 in. The feeds are positive and easily controlled by the operator; they are .007, .012, .016, .021, .033, and .046 in. per revolution of the spindle. An automatic stop is provided so that the feed may be disengaged at any predetermined depth; the sleeve is graduated. The table on the 28 in. machine is 24½ in. in diameter and has a traverse of 15½ in. The table arm has a large flat bearing on which the table rests; the arm is bored and faced in place, thus giving each drill a thorough test before leaving the shop. The head has a traverse of 23½ in. It has a long bearing on the column and slides on wide ways, being controlled by means of a rack and pinion.

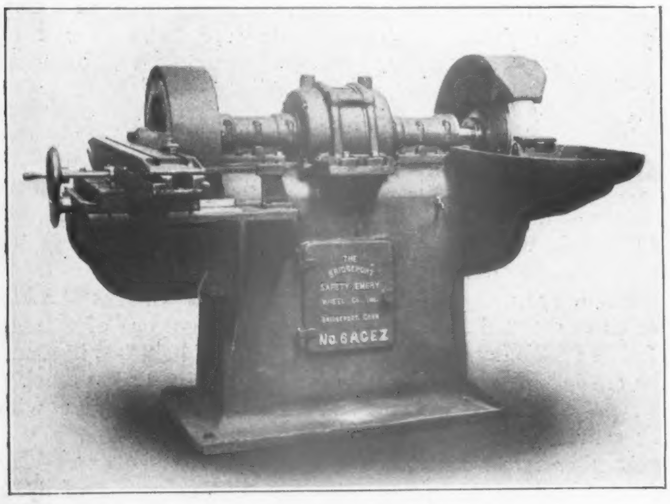
The machine shown in the illustration is arranged for a belt drive, but a 3 hp., 1,400 r.p.m. motor may be applied.



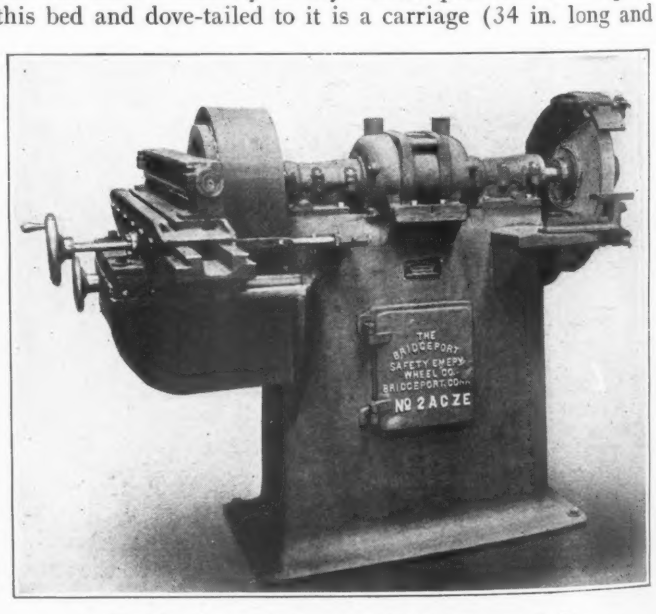
Aurora 28-Inch Upright Drill

COMBINATION MOTOR DRIVEN GRINDERS

THE combination grinders shown in the illustrations are specially valuable where there is only a limited amount of work of any one kind and where floor space is limited. The combination practically furnishes two machines to occupy the space of one. These machines, which have been developed by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., may be made in a number of different combinations, but in each instance the heavy bracket is cast at the left-hand end of the cabinet. The top of this bracket is finished to receive a dove-tailed table which is gibbed to the bracket and is fed back and forth on the base by means of the hand wheel and screw. On the top of this table and pivoted at the center is a bed which may be tilted in such a way as to grind slightly concave or it may be set square to grind perfectly flat. Clamping screws at each corner will hold it securely in any desired position. On top of this bed and dove-tailed to it is a carriage (34 in. long and 6 in. wide) with two T-slots. This is gibbed to provide for wear and is operated back and forth in front of the grinding wheel by means of a rack and pinion which is controlled by a hand wheel. The work may be clamped to the carriage, or if desired a magnetic chuck may be provided.



Combination Grinder with Wet Grinding Attachment at the Right



Combination Grinder with Knife Bar at Left

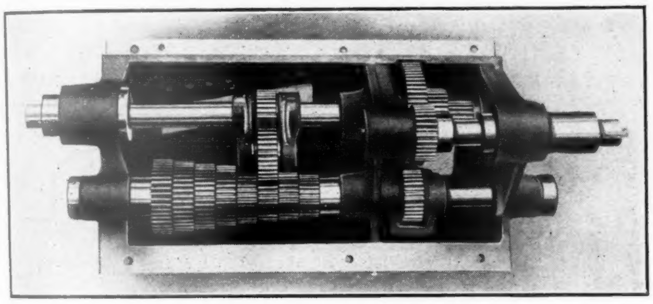
One of the illustrations shows a knife bar on this carriage for grinding machine knives; by means of this arrangement, the knives may be set to grind at any angle or square across. The photographs show two different arrangements of grinding wheels at the right-hand side of the machine. In one instance, a wet tool grinder is furnished, while in the other an ordinary type of floor grinder is used. If desired a twist drill attachment may be furnished.

The motor is equipped with a special frame, so that it fits well down into the base of the machine; it has a large spindle, the diameter in the bearings being 1¾ in. The distance between wheels is 35 in., and the length of the shaft over-all 50 in. The height from the floor to the center of the spindle is 40 in. There are two sets of balls in each of the ball bearings, these bearings being 10½ in. in length.

The machine covers a floor space, not including the overhang, of 45 in. x 23½ in., and weighs 1,800 lb., when crated for domestic shipment.

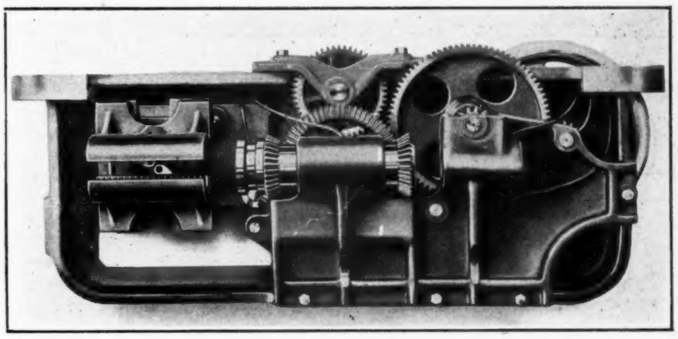
THIRTY-SIX INCH MOTOR DRIVEN GEARED HEAD LATHE

The Pittsburgh Machine Tool Company, Braddock, Pa., has recently redesigned its line of heavy lathes. In general, the 36 in. x 12 ft. lathe, which is described herewith, is typical of the other sizes. This particular lathe has a swing over the ways of 36¾ in., a swing over the carriage of 25½ in. and a distance between centers of 5 ft. The headstock is of the enclosed type and so constructed that it can be easily dismantled. Twelve changes of speed are provided through the head and are controlled by two clutches and three gear shifts; the ratio of the gearing in the head is 63.5 to 1.

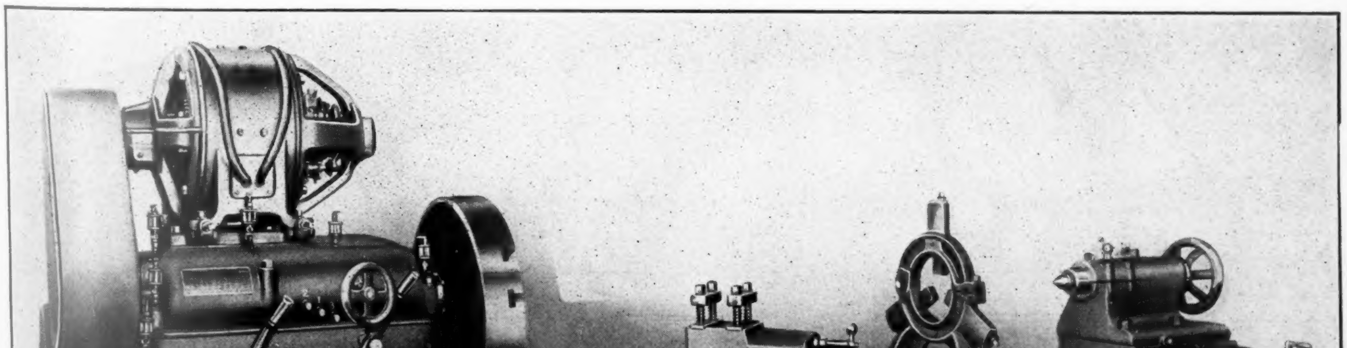


Interior of Feed Box

A motor drive may be supplied as shown in the illustration. With a direct current motor any reasonable number of spindle speeds may be obtained by the use of a variable speed controller which is operated from a handle at the right hand end of the carriage. If an alternating current motor is used, it is controlled by a Cutler-Hammer rotary switch and automatic starter. If a belt drive is desired, a 6 in. belt is used and 24 spindle speeds may be obtained with a two-speed countershaft. The main spindle is of hammered steel and hollow. The front spindle bearing is 6 in. in diameter and



Interior of Apron



Pittsburgh 36-Inch Geared Head Lathe With Motor Drive

8 in. long, while the rear spindle bearing is 4 in. in diameter and 6 in. long.

The feedbox furnishes 41 different lateral feeds; power cross feed is also supplied. The tailstock is of heavy design and is arranged with a pawl which engages with a rack cast in the center of the bed. The tailstock is moved by power through gearing. The tail spindle is 4½ in. in diameter. The apron is of double bearing construction; its arrangement is clearly shown in the photographs. A locking device prevents the throwing in of two feeds at the same time. The carriage is fitted with wipers which ride on the vees, keeping them clean and well oiled. The bridge is 12 in. wide and the carriage has a bearing on the ways of 44 in.

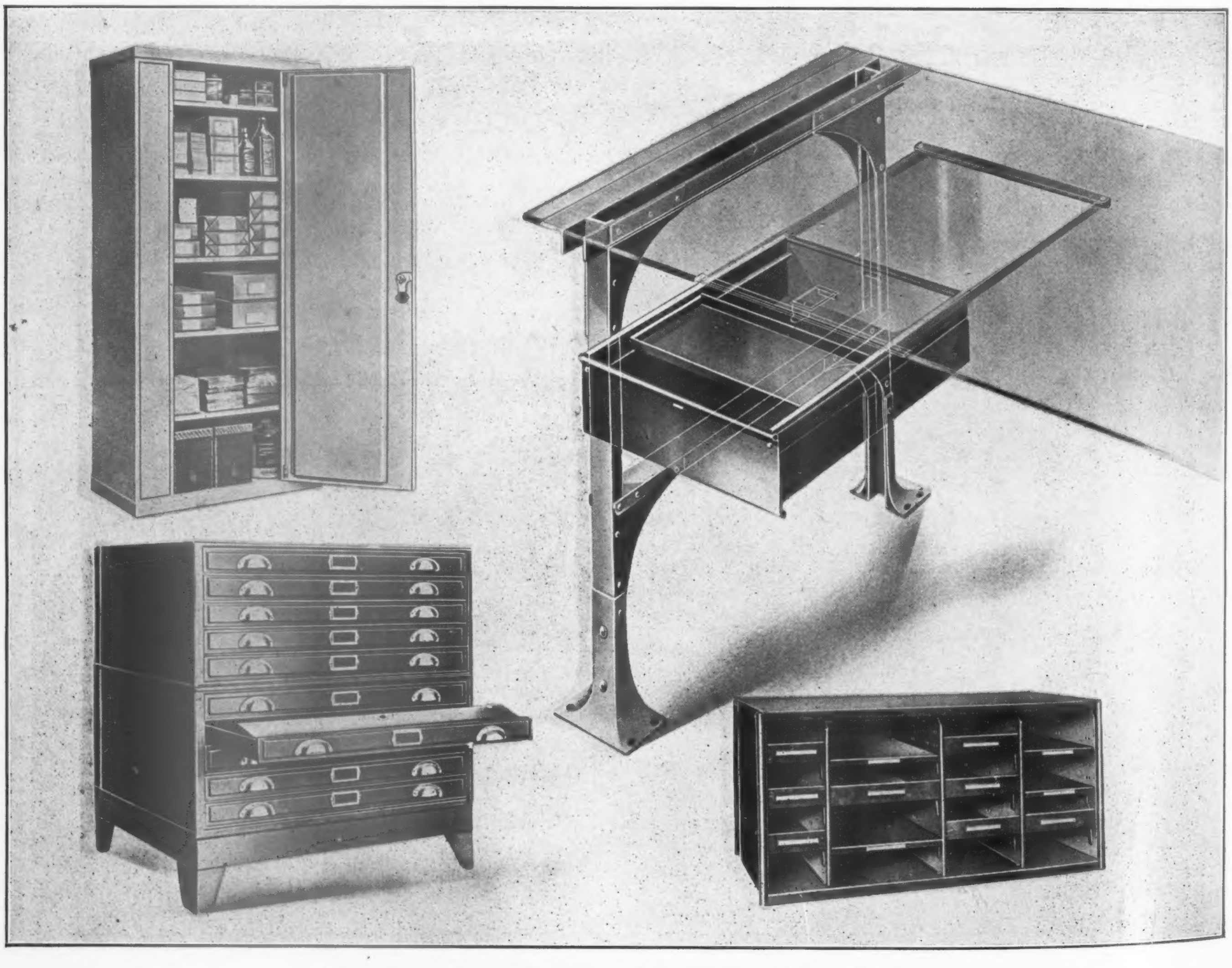
The bed is 29 in. wide and 20 in. deep. The front vee is exceptionally large to provide ample front bearing for the carriage. The taper attachment is of strong and rigid construction. The net weight of this machine with a 12 ft. bed is 16,000 lb.

PRESSED STEEL EQUIPMENT FOR SHOPS AND OFFICES

THE many small cabinets, bins, drawers and boxes used around shops and roundhouses are as a rule made in the car shop. The cost of manufacturing them is necessarily high but there has been no alternative in the past as suitable equipment could not be secured otherwise. To meet the demand for such articles the Lyon Metallic Manufacturing Company, Aurora, Ill., is now producing a number of the types most commonly used in a variety of sizes suitable for railroad use. Being made of steel they are light and strong and more durable than similar equipment constructed of wood.

For tool rooms and store rooms a subshelf has been developed which simplifies making small compartments. The unit is collapsible and adjustable and fits into the standard Lyon shelving, which consists of a number of uprights into which clips can be set to hold the shelves. By reversing the shelf the compartment may be made into a bin. The shelves can be adjusted on 1½-in. centers without the use of tools and when not in use can be knocked down so that they consume practically no space.

Another useful adjunct for shops and roundhouses is a blueprint cabinet so arranged as to permit the storing of many sizes of drawings in a single size of cabinet. One of the principal advantages of these cabinets lies in the fact that they are fireproof. The cabinets are finished in baked enamel and can be furnished in five drawer sections ranging in size from 24 in. by 24 in. to 48 in. by 36 in. This device is shown in the illustration as well as a different type designed for the storage of a workng supply of stationery and printed forms. The size of this cabinet as regularly made is 36 in.



Shelving, Cabinets and Drawers Designed Specially for Shop Use

by 18 in. by 75 in. It has movable shelves and can be securely locked.

Shop men who have been troubled with the loss of valuable tools will be interested in a thief-proof, steel bench drawer. It is equipped with a one-piece steel top which is also used to form the slide. Although the drawer may be torn from the bench and be entirely separated from it, the contents will still be secure.

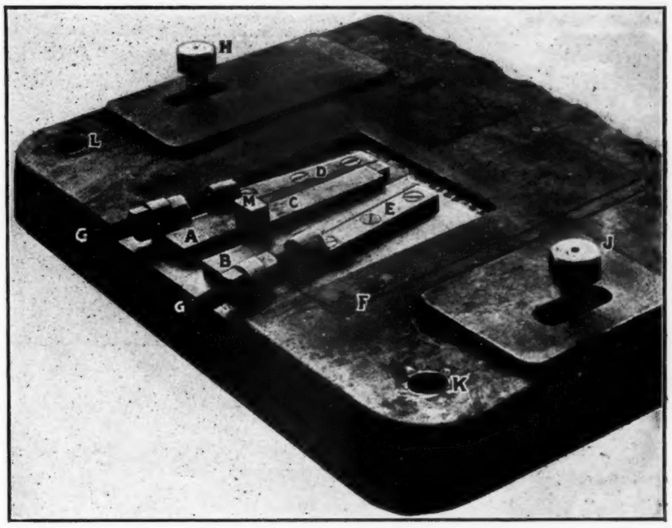
ADJUSTABLE ANCHORAGE FOR MOTORS

A DEVICE designed to insure accurate alinement and permanent anchorage for electric motors is being marketed by the Adjustable Anchorage Company, 1502 Ford building, Detroit, Mich. This anchorage permits a limited adjustment of the motor in all directions and may be used on either direct connected or belt-driven motors.

A half-view of a bed plate with the anchorage applied is shown in the illustration. The motor is set on the bed plate with keys *C* set tightly in slots in the bottom of the motor at both ends, the lugs *M* pressing against the motor base. To rotate or move the motor to either side, the bed plate bolts *H* and *J* are loosened and the wedges *A* and *B* moved alternately in or out by means of the screws *G*. The wedges bear on the surface of the guides *D* and *E*, the taper of the wedges thus moving the keys laterally, which in turn move the motor with them.

This anchorage, by providing universal adjustment of the motor in a horizontal plane, makes possible an accurate alinement, which once obtained is permanently held by the key *C*. This is of particular value in the adjustment of magnetic clutches and in the perfect alinement of the shaft, which eliminates eccentric movement and thus prolongs the life of the journal bearings.

To tighten or loosen a chain or belt the key *C* is loosened by drawing out the wedges slightly and moving the motor by means of a screw set in a lug cast on or a stud tapped in the bed plate at *F*. This device may be installed on old motors or on new work at a comparatively small cost.



Arrangement of Adjustable Anchorage for Motors

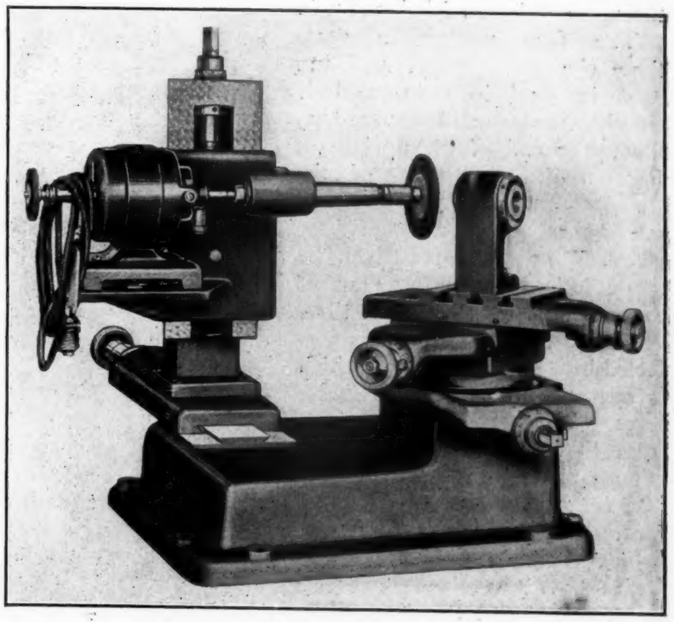
SOLVING THE CUTTER GRINDING PROBLEM

THE truth of the old adage that "Necessity is the mother of invention" is brought out in the production of a new profile grinder, which was originally designed and constructed exclusively for the requirements of a large milling cutter establishment. The performance of this machine, which is shown in the photograph, in its grinding of concave and convex cutters, cutters for fluting drills, rounding corners on side and face mills, and other special grinding jobs, has been considered of sufficient value to cause its originators and manufacturers, the Cleveland Milling Machine Company, Cleveland, Ohio, to place it at the disposal of manufactories and repair shops for installation in their tool rooms.

The wheel carrying spindle is direct connected to the shaft of the type *D* Dumore universal 110-volt motor which is furnished with the machine. The spindle has adjustable bronze bearings and carries a wheel 4 in. in diameter, ¼-in., face with a ⅜-in. hole. The bracket carrying the motor and wheel spindle is mounted on a vertical housing and is adjusted by a screw provided with a micrometer dial.

Arbors for holding the work are held in a sleeve which revolves freely in the work holding posts. Four posts are furnished with No. 9 and No. 7 Brown & Sharpe tapers, one with a ½-in. straight hole and one flat block for holding flat tools, in order to cover all classes of work capable of being done on the machine. The posts fit into three T-slots in the upper compound slide, thus providing for a wide range of work. The two upper slides are used to bring the work in the proper sweep across the face of the wheel, and are in turn mounted on a swivel block, which is pivoted to the bottom slide.

The maximum radius that can be ground is 3 in. on either concave or convex cutters up to 12 in. in diameter. A gage is furnished to set the work in the proper relation to


Motor Driven Profile Grinder

the wheel and when the slide is set for any given radius the machine will always grind that radius regardless of the continued adjustment of the two upper slides. A simple and

convenient tooth rest is furnished with range enough to cover all work within the capacity of the machine. All screws are provided with readable micrometer dials and the slides are accurately scraped and provided with gibs for taking up the wear. The machine occupies a bench space of 24 in. by 30 in. and weighs 217 lb.

A HIGH POWER MULTIPLE SPINDLE DRILL

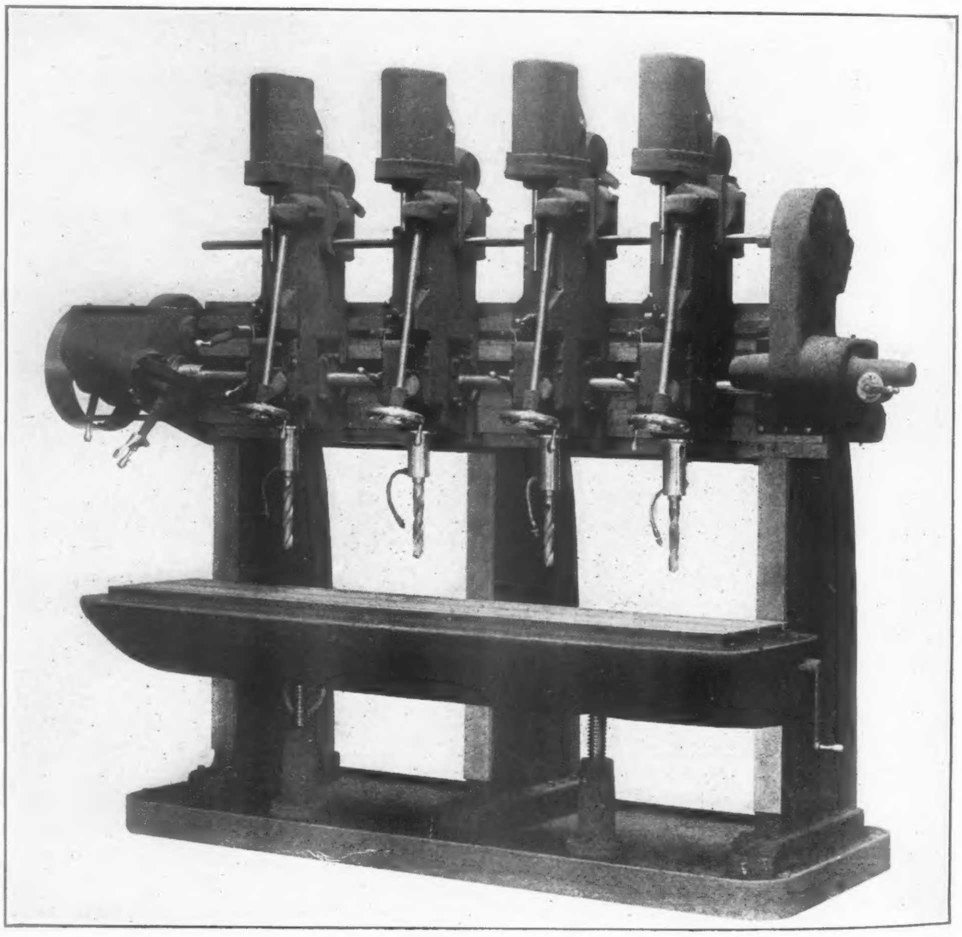
THE multiple spindle drill shown in the illustration is a heavy service production tool especially intended for use in locomotive and railway shops and will be found useful where the work includes heavy gang drilling or heavy jig drilling. When used on jig work the compactness of this drill enables one operator to keep a greater number of spindles—either singly or in groups—continually in operation, and as a result the operator is kept constantly reloading the jig while some of the drills are kept constantly producing.

The speed mechanism is attached to the upper end of the upright at the left end of the frame and provides a range of six speeds from 25 to 186 r.p.m. It consists of two cones of hardened steel gears, back gears, and a hardened roll-in gear. There are three gears on each of the cones and these when used in conjunction with the back gears furnish the speed changes which are selected by sliding and dropping the roll-in gear into mesh with the various sets of gears on the cones. The shafts in the speed box rotate in Hyatt roller bearings, and the drive shaft, which transmits the power from the speed mechanism to the spindles, rotates in combined radial and thrust ball bearings. Power is applied to the speed box through a constant speed pulley and is transmitted through a Johnson friction clutch.

The feed mechanism gives three changes, namely, .006 in., .009 in. and .014 in. and is tightly encased and fastened to the upper end of the upright at the extreme right end of the frame. The changes are obtained through two cones of three gears each which are driven by the spindle drive shaft. Each of the two cones is fitted with three gears. The feed changes are effected by a slip key method which is operated by an indexed hand lever. The feed is transmitted from the two cones of gears to the feed shaft through miter gears and a worm and worm gear, with end thrust taken by ball bearings. A handwheel is also provided for quickly advancing or returning each spindle.

The minimum distance between spindle heads is 8 in. from center to center. The heads are gibbed to a heavy crossrail by a dove-tail method and are adjustable along the rail by means of a crank handle which operates a rack and pinion. The spindles are provided with No. 5 Morse taper and are driven by spiral gears. The spindle thrust is taken by S. K. F. ball bearings. The drive is located at the lower end of the head, which reduces torque in the spindle to a minimum. Each spindle is counterbalanced and can be driven and fed independently of the others. The levers used to apply the feed and drive to each spindle are interlocking so that the power feed cannot be engaged when the spindle is not being driven. Adjustable stops are provided automatically to disengage the feed when the holes have been drilled to a given depth.

The table, which affords a total working surface of 20 in. by 98 in. and a vertical adjustment of 12 in. by means of a crank handle which actuates two jack screws through a worm and worm gear mechanism, is a substantial box type casting. The jack screws supporting the table maintain its original alinement by receiving the trust of the cutting tools on the direct center line with the spindles. A cored section of the table serves as a reservoir for the cutting compound, and the table casting is shaped on all four sides so as to form a trough in which the cutting compound flows back to the reservoir. The pump which forces the cutting compound to the work is fastened to the upright at the left and is driven directly from the countershaft.



Multiple Spindle Rail Drill

Lubrication is provided by a force feed, gravity flow and splash system combined, which is made possible by the all-enclosed unit construction. The speed mechanism, feed mechanism, and each of the spindle heads are provided with an independent and self-contained oiling system, which insures positive lubrication and economical maintenance.

The contents of each unit are partially submerged in a bath of oil, while the bearings are lubricated by a force feed through individual leads which carry a sufficient flow of oil to flush all enclosed parts on its return to the reservoir.

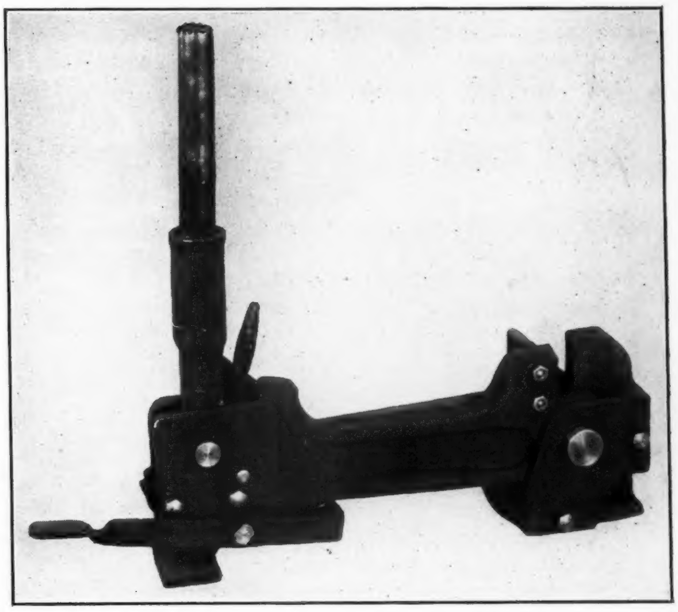
The machine is operated by a 10-hp. motor, weighs about 15,000 lb. ready for shipment, and will occupy a floor space of 56 in. by 144 in. It is known as the No. 23 rail drill and is built by Defiance Machine Works, Defiance, O.

A POWERFUL HAND OPERATED BAR CUTTER

The frame of the bar cutter shown in the photograph is of cast steel and is reinforced by heavy steel plates at the two main bearings; the cutter blades are made of specially treated tool steel in order that they may cut high carbon steel such as is in bars for reinforced concrete construction work.

The shear is fitted with a quick return arrangement which is made operative by throwing a pawl out of engagement by means of the short lever. The shearing blade may be brought into position quickly up to the point where the blade comes in contact with the bar to be cut by the use of a foot lever, whereas the actual cutting of the bar is only accomplished by operating the long lever and ratchet. The quick adjustment saves a great deal of time, as the ratchet operation is necessarily slow on account of the great leverage required to cut off heavy bars. The only spring used in this machine is one for holding the ratchet pawl out of engagement, in order that the movable cutting jaw may be returned to the starting position by its own weight.

This bar cutter weighs 178 lb. and is light in comparison to its shearing capacity. It will cut square twisted reinforcement bars, or mild steel bars, cold, up to 1¼ in., round mild steel bars up to 1⅜ in. diameter, and flat mild steel bars ¾ in. thick by 3 in. wide. It is known as the Wallace No. 167 bar cutter, manufactured by the Wallace Supplies Manufacturing Company of Chicago.



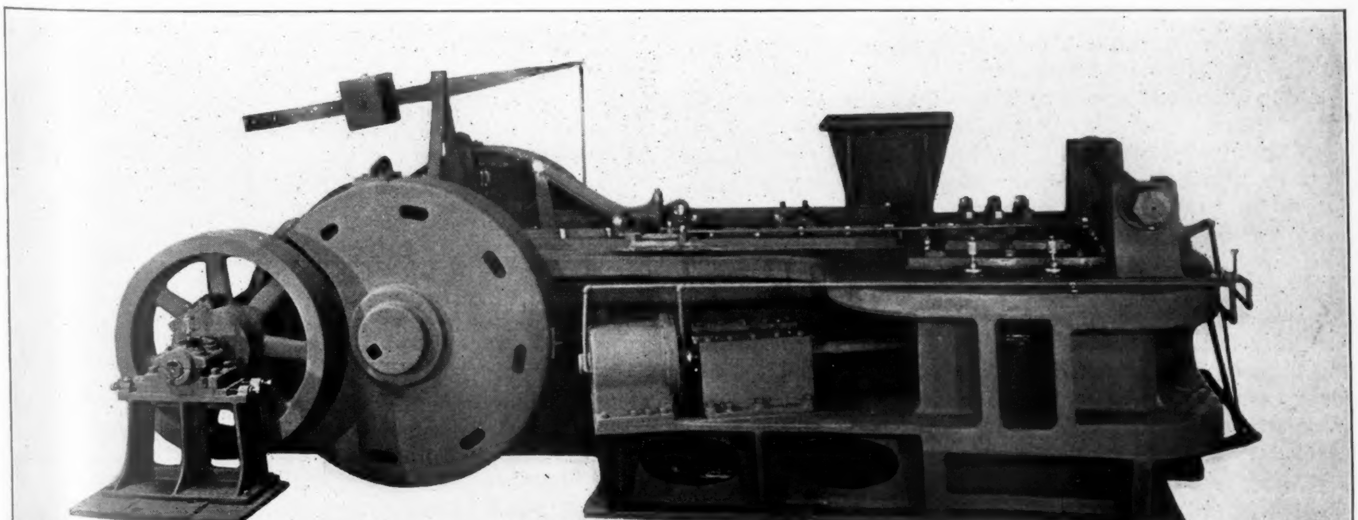
Convenient and Powerful Bar Cutter

The machine is 8 in. wide by 35 in. long and the lever, which consists of an ordinary piece of iron pipe, is 6 ft. in length. The height from the floor to the top of the cutting jaw is 11 in.

SPECIAL AJAX UPSETTING FORGING MACHINE

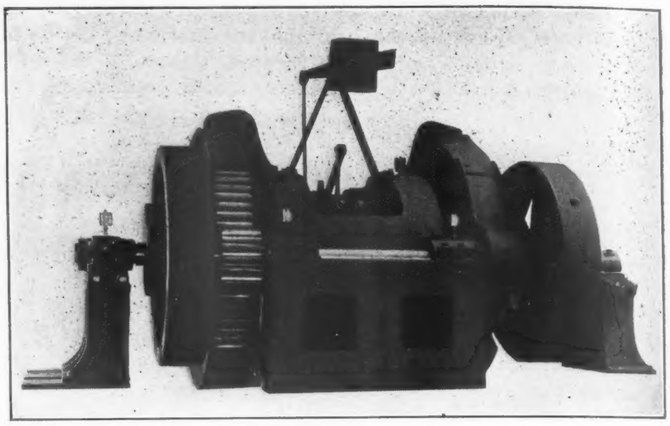
Stern necessity, under war conditions, forced many of the machine tool manufacturers quickly to develop new and unusual designs in order to assist the government in the production of munitions and supplies. As an example many interesting articles might be written on what was done in the manufacture of forgings, some of them of the most intricate designs and others of simple design but of unusual proportions. Fortunately, some of the special machines which have been designed and many of the lessons which have been learned may be applied to advantage under normal industrial conditions.

Many large forgings are required in the manufacture and



Side View of Ajax Upsetting Forging Machine with Extra Large Stock Gather.

maintenance of railroad equipment and doubtless an upsetting forging machine with an extra large stock gather, which was designed by the Ajax Manufacturing Company, Cleveland, Ohio, for making forgings required in the construction of artillery at the Ford motor car plant at Detroit, Mich., may be used to advantage for some of this work. This machine, which is shown in the illustrations, was so designed that an extra long stroke may be obtained after the gripping die has closed, thus holding the stock while the upsetting ram or tool performs its upsetting operation. The moving or gripping die is operated by an air cylinder and the heading tool or ram has a travel of 24 in. after the dies are closed. This stroke can, in cases of emergency, be increased to 26 in. The die space will accommodate a die 35 in. high and 27½ in. long. The crank shaft has a gear on either end, giving a double gear drive, thus protecting the shaft from torsional stresses. One of the views shows clearly the double gear drive with the two safety flywheels which are provided with safety shear pins. The crank is 13 in. in diameter.



Showing Double Gear Drive with Two-Safety Fly Wheels.

The air cylinder operates under 100 lb. pressure. The floor space occupied by the machine is 24 ft. by 15 ft. and the total weight of the machine is a little over 100 tons.

A NEW ANGLE ON MILLING MACHINES

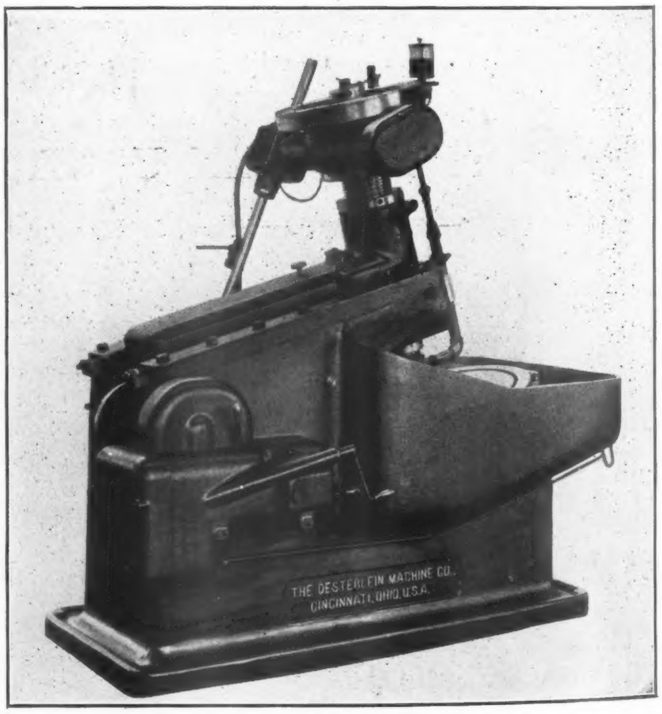
THAT there is apparently no limit to which the designer will go in the search for the practical application of every possible principle which will influence the efficiency of machine tool production, is strikingly illustrated in the tilted rotary milling machine shown in the illustration, in the design and construction of which will be noted an entire disregard for all precedent.

It is stated that the successful development of the Ohio tilted rotary milling machine, which will be exhibited at the June mechanical conventions at Atlantic City by the Osterlein Machine Company, Cincinnati, Ohio, has produced a continuous production milling machine which has eliminated a large part of the idle time between cuts, has increased the rigidity by a reduction in the number of parts, and insures a sufficient supply of lubricant for cooling the cutters.

The usual time spent in returning a longitudinal feeding table, removing the finished work, clamping the new piece in the fixture and again bringing the cutter to the position for cutting, is obviated in this type; by the substitution of continuous milling, this time is converted into production time, with a consequent increase in the output per hour. This is accomplished by the rotary table which carries the work to the cutting position; during the cutting operation the finished work is removed at the opposite side of the table and new work is set up.

This continuous operation not only eliminates lost time, but it sets the pace for removing and setting up the work. The cutter may be held in a fixed position and the table rotated continuously by automatic feed for continuous milling, or the cutter may be reciprocated radially in combination with an intermittent motion of the table controlled by an indexing mechanism. This indexing mechanism provides for from 2 to 72 divisions and the table revolves rapidly between divisions, in order to reduce the idle time. By feeding the cutter radially over the surface of the work the loss of time between milling surfaces is avoided on such jobs as cannot be compactly spaced. Other advantages are that the non-productive time of cutter approach is avoided, the cutter travels the shortest possible distance, two or more simple fixtures may be used instead of one large fixture, and the machine is practical when applied to small quantity lots.

The body of the machine is cast in one piece and no bolts, elevating screws or gibs are subjected to the load of the cut. The general lines of the machine may be said to resemble a punch press or shear. The working surface of the table and the cutter spindle are both contained in this body casting and the possibility of relative deformation under load of the cutter and work is avoided. As the body of the machine is directly under the circular table there is nothing to depreciate the anvil-like rigidity from the table bearing to the floor.



Ohio Tilted Rotary Milling Machine

There are no overhanging parts on the machine; the ram bearings are extended in front so that even in the advanced position of the cutters the full length of the ram is effective.

A worm wheel of 28-in. pitch diameter driven by a worm of 1¼-in. pitch and 4-in. diameter drives the 30-in. diameter table which is set at an angle of 150 deg. This worm wheel is set as close to the table surface as the taper table bearing will permit and is bolted and pinned to the table at the ex-

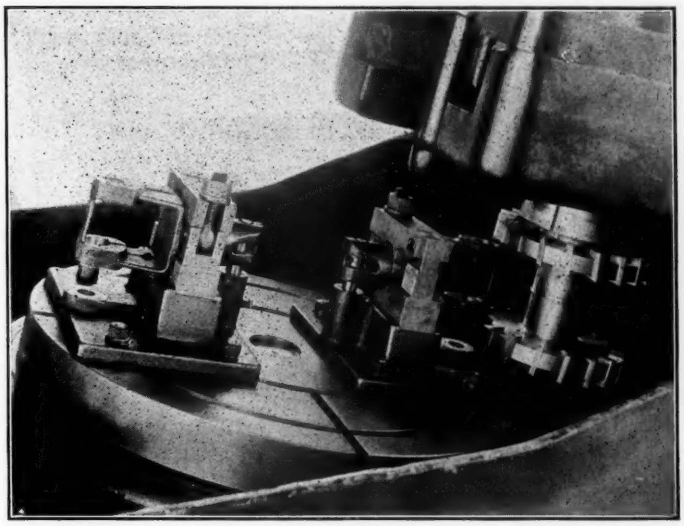
treme end of the bearing; the central stud merely serves as means for alining the worm and the table. The latter is provided with two circular and four radial T-slots for the purpose of clamping the fixtures. The ram bearing has a surface of 1,000 sq. in. and three gibs permit of adjustment in all directions.

The machine is driven by a 4-in. belt over the pulley located on the side of the machine, either from a line or a jackshaft, or by a motor mounted on a special base plate placed on the top of the machine. Power for driving the spindle which carries a No. 16 Brown & Sharpe taper is transmitted from the pulley through mitre gears to an intermediate shaft which connects with the first change gear shaft in the speed box by means of a second pair of mitre gears. A single pair of change gears connect the first and second change gear shifts; "pick off gears" are used on the two shafts and give 30 spindle speeds, using 15 pairs of change gears.

The intermediate shaft is made in two sections, which are connected by a coupling, by the releasing of which and turning the first change gear shaft through half a revolution, the opposite end of the upper half of the intermediate shaft couples with the lower section. This reverses the direction of rotation of the spindle and allows the use of either right hand or left hand face mills as desired. The intermediate shaft is splined at the upper end, and permits the pulley shaft and first intermediate shaft to trunnion, to allow reciprocation of the ram. Ball bearings are used wherever practicable throughout the driving mechanism.

The spindle, which is adjustable vertically by means of a graduated collar, is carried in a sleeve, on the upper end of which is attached the speed box casting. The lower spindle bearing is 4½ in. in diameter and runs in a phosphor bronze bushing. The upper spindle bearing is a radio thrust ball bearing. A clutch in the end of the spindle provides for a positive driving of the arbors.

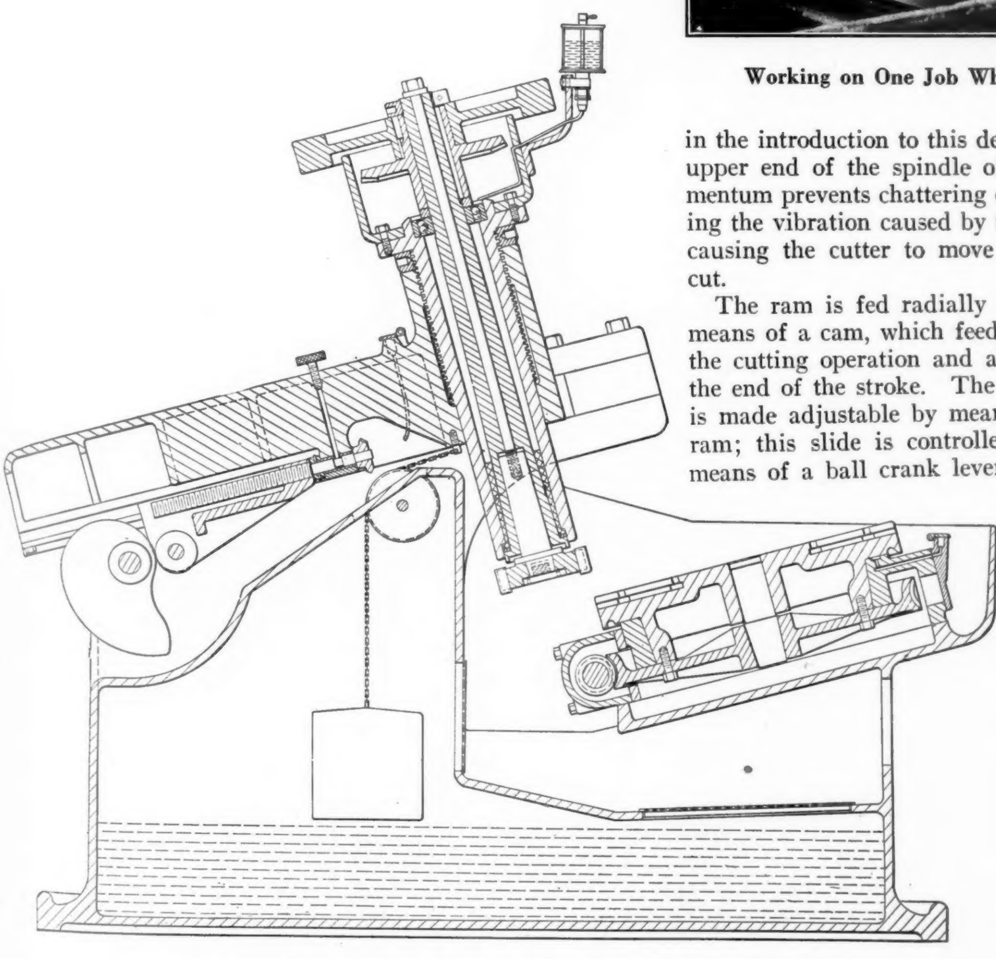
An example of one of the practical applications of principles which influence the efficiency of production referred to in the introduction to this description, is the mounting on the upper end of the spindle of a 250-lb. flywheel, whose momentum prevents chattering of the cutters as well as eliminating the vibration caused by the lacklash in the driving gears, causing the cutter to move smoothly into and through the cut.



Working on One Job While Another Is Being Set Up

The ram is fed radially over the surface of the table by means of a cam, which feeds the ram forward slowly during the cutting operation and allows it to drop back rapidly at the end of the stroke. The relative radial travel of the ram is made adjustable by means of a slide mounted under the ram; this slide is controlled from the side of the ram by means of a ball crank lever and is clamped by means of a knurled knob. A double row ball bearing serves as a cam roller.

The pulley shaft extends through the machine and drives the feed box mechanism; the operations of the feed box are controlled by a push rod extending along the side of the machine to within reach of the operator. The cam shaft is driven by a worm and worm wheel in the feed box. A four-gear feed change mechanism regulates the feed of the table when the continuous table motion is used or the rate of revolution of the cam when the indexing mechanism is used. The cutting feeds, therefore, are established by the ratio of these change gears. The index mechanism may be omitted for a machine on which only the continuous feeding table is desired, or the indexing mechanism may be added to a continuous feeding machine at any time. It should be noted that the feed change gears regulate the rate of travel of the ram and the throw of the cam regulates the length of travel of the



Sectional View of Ohio Tilted Rotary Milling Machine

ram. A crank operated shaft is provided so that the feed mechanism may be operated by hand when setting up or trying out a job. A lever is also provided for tripping the index mechanism.

Lubrication is provided for by a pump of 35 gallons per minute capacity, attached to the side of the machine and driven by a belt from the pulley shaft. The lubricant is raised under pressure to a distance above the machine and expanded in a large pipe before it falls on the cutter and work; it drains from the chips which are deposited in a pocket provided in the base at the low end of the table, into a 60 gallon reservoir in the base. A large central distribution oiler on the speed box provides for speed box and spindle requirements and a similar oiler lubricates the pulley shaft. A central oiling point located at the top of the ram provides distribution to the ram slide and similar provisions are made for feed box mechanism and for the table bearings. Ample provision is therefore made for the lubrication of all parts.

THE INTERNAL GRINDER IN THE LOCOMOTIVE SHOP

THOSE who have benefitted by their recognition of the cylindrical grinder's place in the locomotive shop for finishing piston and valve rods, and crosshead and other pins will be interested in the internal grinding machine shown in the illustrations.

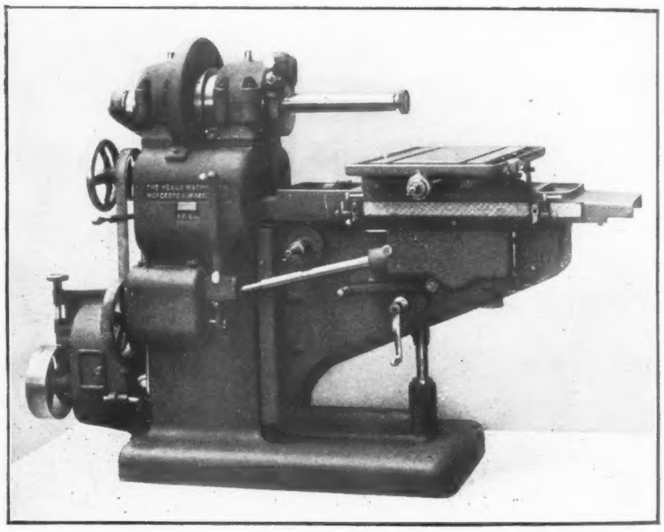
In repairing valve motion levers, parallel rods and various other similar parts, where the holes in the rods or in the bushings are worn oblong or rough, or the holes in the levers have become distorted, the use of this type of grinder will commend itself; these holes can be ground true and thus avoid the necessity for renewing the bushings or reaming the lever. Reaming would in some cases be the quicker operation, but it would not produce as true a hole and would result in enlarging the hole more than by grinding. On parts which have been warped in casehardening it is much easier to true the holes by grinding than by any other method.

Then, too, this machine may be used to good advantage on

Trueing Up the Bushing Fit in a Side Rod

various air brake parts, including triple valves. The valve chambers in the top heads of air compressors when worn, may also be refinished on it. Steam and air cylinders may be refinished when worn or cut. To refinish a very badly worn cylinder may require more time than on a boring machine, on account of the large amount of metal to be removed in order to true up the entire surface, but even if this be the case, grinding will generally be the more economical when considering the life of the cylinders.

The article to be ground is secured to the table, which may be adjusted so that the work will be brought in line with the grinding wheel spindle. The illustrations show a No. 60 internal grinding machine manufactured by the



Heald No. 60 Cylinder Grinder

Heald Machine Company, Worcester, Mass. This company expects to exhibit a machine of this type at the June mechanical conventions at Atlantic City.

Notable features of the machine are a large crosswise adjustment of the work, large vertical adjustment of the knee, multiple speeds for the rotation of the head, quick change gear boxes for speeds and feeds, and micrometer readings throughout.

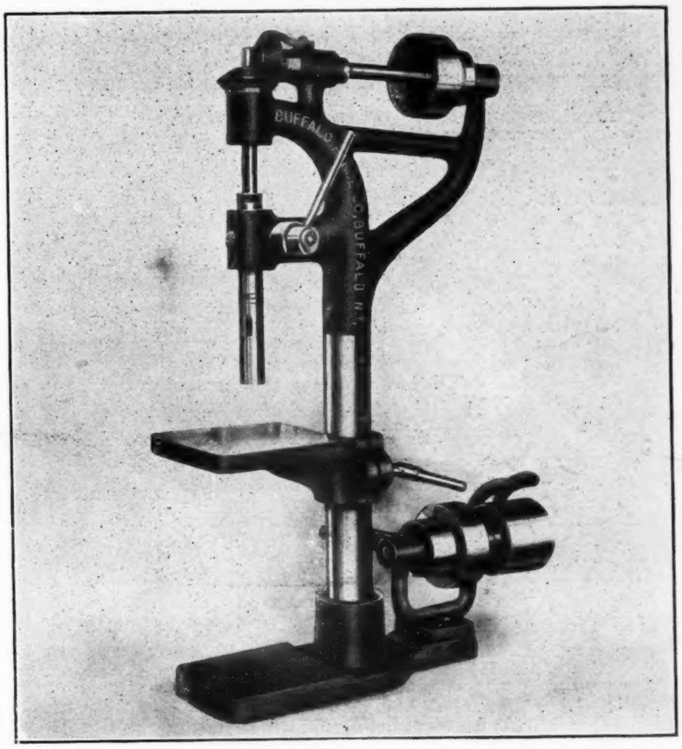
The proportions of this grinder, which occupies 38 in. by 90 in. of floor space and is driven by a 3-hp., 1,200 r.p.m motor, are well conveyed by the general photograph; another photograph illustrates the grinder performing a characteristic railroad shop operation in the grinding of an elongated bushing fitted in a locomotive side rod. The main table is 13 in. wide by 52 in. long, with a finished top 10 in. wide by 24 in. long, and has two T-slots and alining grooves. The cross slide table is 18 in. wide by 36 in. long, provided with a finished top 14 in. wide by 28 in. long, with two T-slots. The vertical adjustment of the knee is 3½ in. Micrometer dials are furnished for horizontal and vertical adjustments. Spindles regularly furnished with the machine will grind holes of three or more inches in diameter by 15 in. long; the standard grinding wheels used are 3½ in. and 4 in. in diameter by ¾-in. face, and are rated from 4,400 to 5,800 surface ft. per minute. The maximum distance of the finished pad on the cross slide table below the center of the grinding circle is 7½ in.; to the main table, 12 in.; the minimum distance is 4 in. and 8½ in., respectively.

A POWER BENCH DRILL FOR ACCURATE WORK

THE 10-in. power bench drill shown in the photograph is rather small for use in a railroad shop and yet there are places in the tool room or in other departments where it is desirable to have a machine of this kind for small and accurate work. The frame, excluding the base, is in one piece, simplifying the construction, and helping to keep the shafts and gears in perfect alignment. The machine will drill holes quickly and accurately up to 9/16 in. in diameter and to the center of a 10-in circle. The height over all is only 33½ in. and the machine weighs 110 lb.

The spindle is ¾ in. in diameter in the sleeve and has a travel of 3 in.; the column is 2½ in. in diameter; and the table measures 7 in. by 8 in. The greatest distance between the base and the spindle is 16 in., while the greatest distance between the table and the spindle is 9¾ in. The work table is adjustable up or down on the column or may be pushed to one side, thus allowing the base to be used as the table. The base is accurately planed and has countersunk bolts.

As may be seen, the upper cone pulley is supported between the bearings instead of being overhung, thus tending to balance the machine and relieve the frame from undesirable stresses. The countershaft is supplied with tight and loose pulleys and a belt shifter. The feed lever and spindle are held in position when idle by means of a friction spring, thus preventing the spindle from slipping down on to the work or the table. These drills are made by the Buffalo Forge Company, Buffalo, N. Y.



10-Inch Power Bench Drill

A NOTABLE ADVANCE IN GRINDING

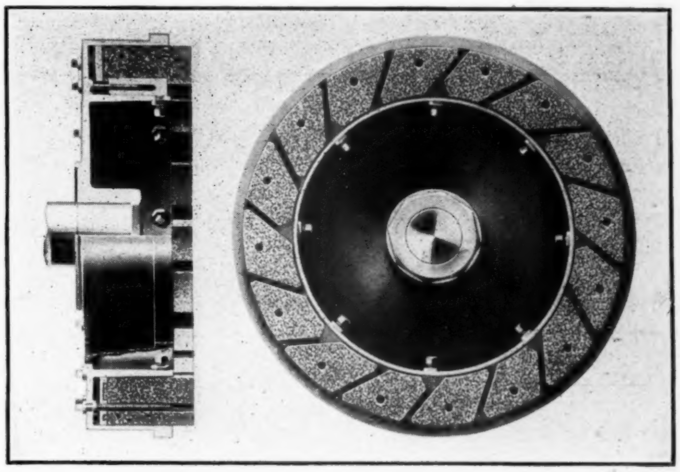
THE guide bar grinder illustrated herewith is noteworthy because of two significant steps forward in the development of large surface grinders. The basic improvement—a radical departure—is the grinding wheel whose chief characteristic is in its sectional or built-up construction. The origin of the design of this wheel emanated from an analysis of what happens between the wheel and the work, and practice is bearing out the value of the theory of a special provision for the regular and constant elimination of grindings and loose grit from the face of the wheel, which is achieved by the clearance between the blocks.

It will be seen that 16 blocks of the required abrasive material are inserted between the inner and outer flanges on the face of a carrying disk or chuck and are held in place through the adjustable pressure of wedges set in at the bases of the blocks and controlled by set screws and lock nuts through the inner flange, the combination forming a grinding wheel which is 32 in. in diameter.

The sectional view gives a clear idea of the manner in which the grinder blocks are controlled for lateral adjustment and shows the adjusting screws retained by collars at the back of the carrying disk, and screwed through the plates into which the grinding blocks are securely dovetailed. It will be noticed that sufficient adjustment has been provided to allow for practically the entire wear of the blocks. It is claimed that the sectional wheel will not "gum up," because it throws off through the grooves between the blocks the refuse from the wheel and the metal, which otherwise being unrelieved, imbeds itself in the face of the wheel, gumming it up, making necessary frequent redressing. Due to this chip relieving feature, it is stated that continuous fast and heavy grinding may be done with a sectional wheel of 4-in. width of face, where the limit of face for a solid wheel is usually 1½ in.

The grinding machine is heavy and rigid. The main bed is of cabinet base construction and supports a three T-slot carriage that travels back and forth on a flat track in front of the grinding wheel properly gibbed to take up wear.

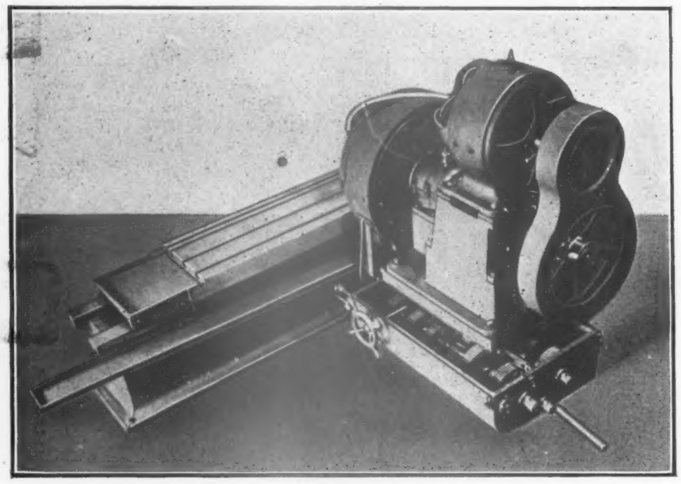
Firmly bolted to this bed at the rear, midway between the ends, is a short back extension bed at right angles to



Showing Construction of Sectional or Built-Up Grinding Wheel

the main bed, with wide flat tracks on which a carriage is mounted, suitably gibbed, and arranged with a screw extending through the main bed, operated from the front side of the machine by a handwheel or by automatic feed, or by hand from the back of the machine, to bring the grinding wheel up to the work. On top of the carriage is a turret,

pivoted at the center for grinding flat faces or by swiveling around to grind slight concaves as desired. The grinding wheel spindle is mounted on this turret and is 5½ in. in diameter, running in ball bearings both radial and end thrust, with adjustable take-ups for end wear, either forward



Rear View Showing Application of Motor and Arrangement of Gearing

or backward. The spindle is driven by means of a large spur gear which meshes into a wide faced fiber pinion on the shaft of the 25 H.P. motor mounted upon the turret.

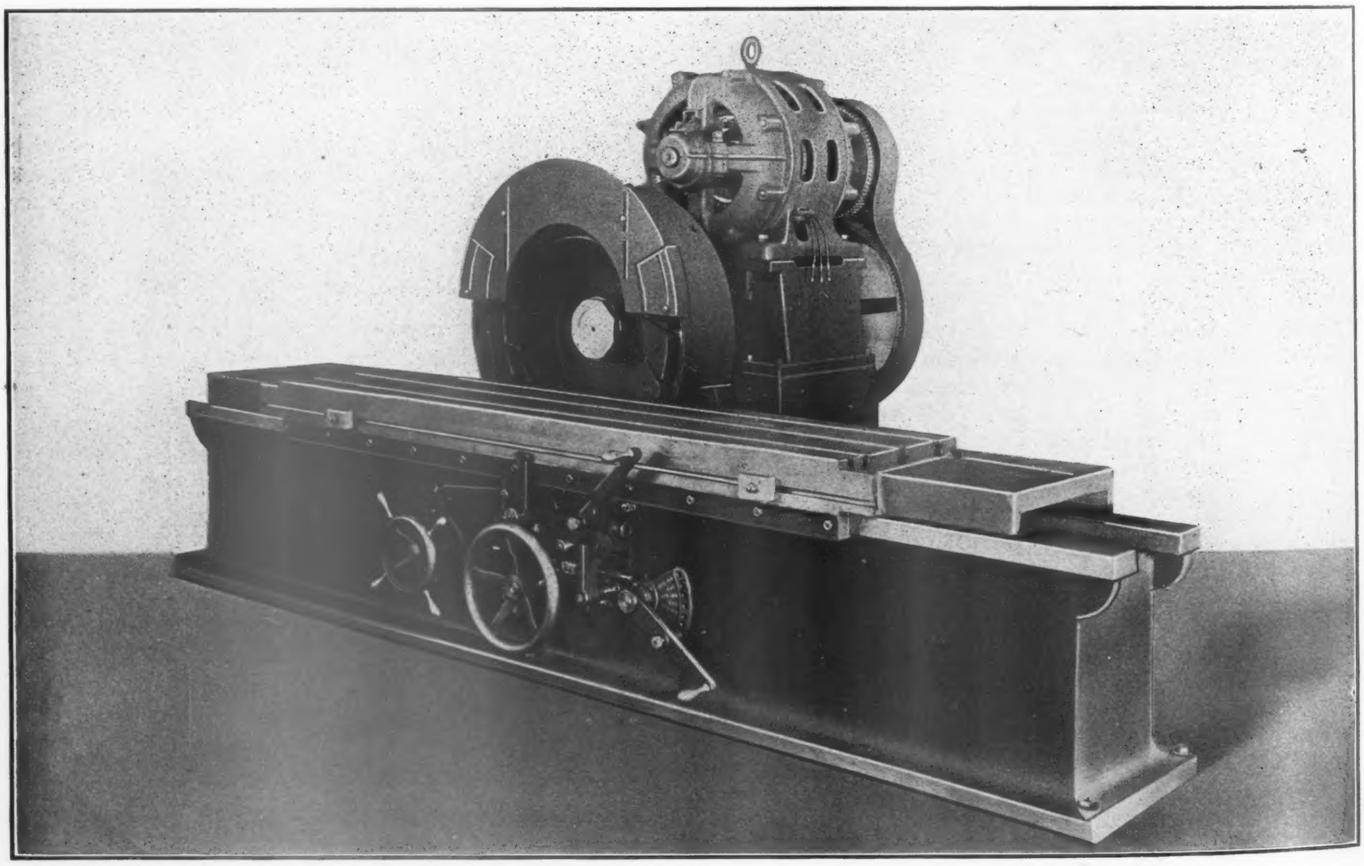
The second important feature in the machine is the partly uncovered in one of the photographs. The desired speed is obtained by adjusting the speed control hand lever, shown at the right in the front view of the machine, in its proper position as indicated on the dial behind it. The lever is locked when in position for any desired carriage travel speed. The hand lever at the left in front of the machine is a carriage control and is locked in both working and neutral positions. There is a corresponding lever at the back of the machine for the convenience of the operator. The large hand wheel is for moving the carriage back and forth in adjustment to the work.

The dogs on the front side of the table may be adjusted for any length of travel up to the capacity of the machine. A centrifugal pump for supplying water to the grinding wheel is furnished with each machine. The front part of the back extension to which the pump is connected has a closed bottom, forming a reservoir. Drip pans on the back of the machine carry the water to the reservoir, thus using it over and over.

At the right and rear of the back extension are gear boxes with removable lids, allowing easy access to the working parts for oiling and making adjustments. One of the gears in the train of backgearing is a friction gear, arranged to slip under excessive load in case anything should get caught.

This machine, which should find many uses in railroad shops, particularly on the grinding of guides, is made in four lengths, 66 in., 86 in., 110 in., and 140 in., and ranges in weight from 12,330 lb. to 18,250 lb.

This sectional wheel guide bar grinder is manufactured by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., who manufacture a general line of grinding



View of Surface Grinder From Operating Side

multiple speed working table or carriage. For convenience in showing the location of change speed gears, which provide a carriage speed of 3, 6, 9 and 12 ft. per minute, respectively, the extension bed in which they operate is

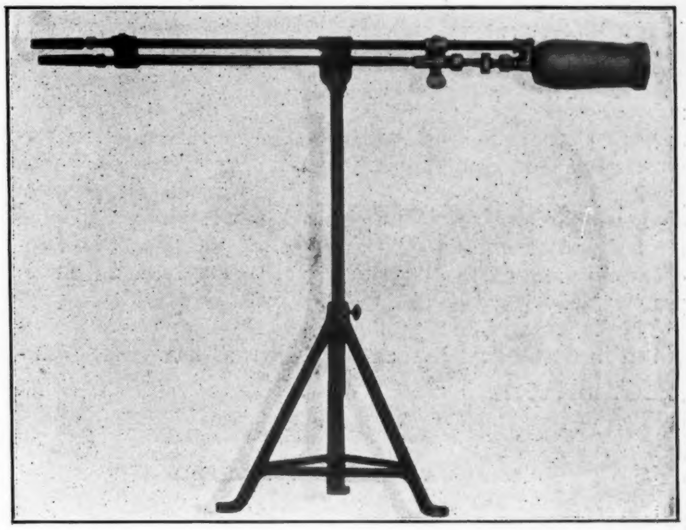
machines of all types and sizes, the pioneer among which was one of the first grinding wheels regularly manufactured and sold under a safety slogan based upon the rigidity of its wheel guards.

A KEROSENE TORCH FOR PREHEATING

A KEROSENE preheating torch has been perfected by Smith's Inventions, Inc., Minneapolis, Minn., which uses compressed air at about 40 lb. pressure, but requires no pressure on the kerosene. The compressed air in passing through the valve draws the kerosene with it and converts it into a vapor. This vapor, as it passes from the torch or nozzle, may be lighted instantly with a match without heating the nozzle. The flow of the kerosene is controlled by a separate valve and the torch flame may be made to vary from 6 in. to 4 ft. in length.

The nozzle shown in the illustration may be replaced by an elbow or other casting, thus deflecting the flame at a right angle or any other direction. The kerosene is drawn into the torch by simply dropping the end of the tube into a barrel or tank of kerosene.

The nozzle may be screwed off, in which case the torch may be used to spray the kerosene in cleaning motors, transmission cases, differentials, and for various other purposes. The adjustable stand is of simple and substantial construction and will be found specially convenient for many classes of work.

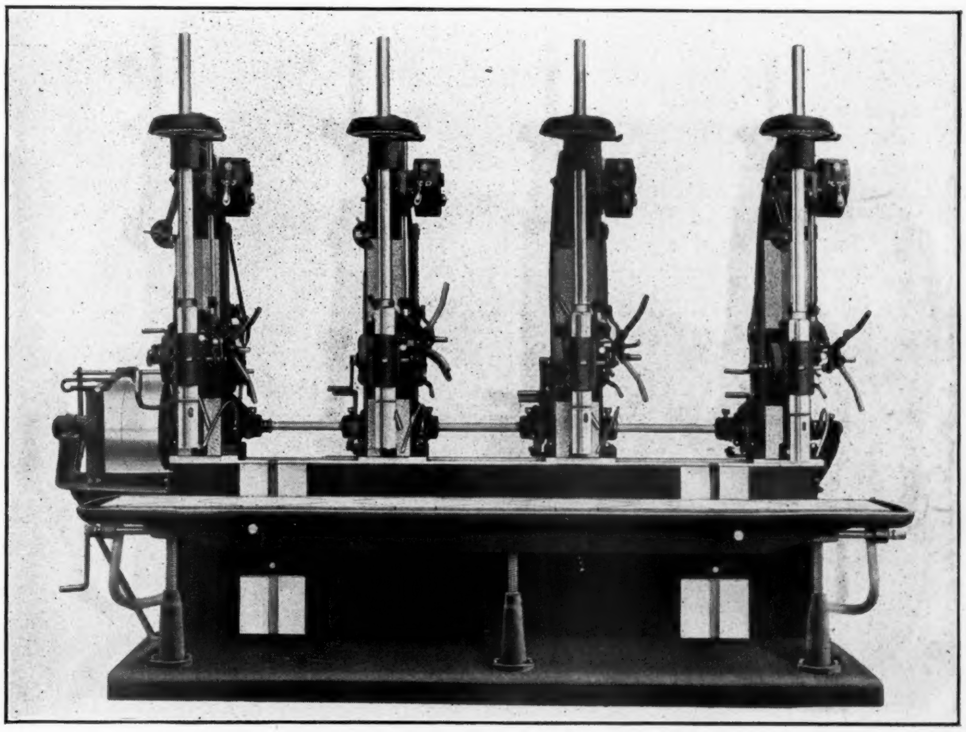


Kerosene Preheating Torch and Stand

TWENTY-SIX INCH ADJUSTABLE HEAD GANG DRILL

THE Barnes Drill Company, Rockford, Ill., has designed a 26-in. gang drill to permit a lateral adjustment of the spindles. In other respects the machine is similar to its standard line of all-geared gang drills. The spindle at the end of the machine nearest the driving pulley is fixed, but the three other heads may be adjusted laterally by means of rack and pinion. This provides a range in centers varying from 18 in. to 96 in. Each spindle will drill to the center of 26 in. and has a vertical travel of 14 in. The table, itself, has a vertical movement of 14½ in., while the sliding heads have a vertical adjustment of 23 in. The greatest distance from the top of the table to the floor is 36½ in., and the greatest distance from the spindle to the table is 37½ in. The table has a plain surface of 19 in. by 120 in., and the machine occupies a floor space of 51 in. by 138 in.

There are eight changes of geared speeds and eight changes of geared feeds on each spindle. The spindles operate independently of each other and all of the adjustments may be made by the operator from the front of the machine. The heads and spindles are counterbalanced, the weights being suspended by the roller bearing sheave wheels. The heads are gibbed to the column faces and may be securely held at any point by quick-acting screw clamps. Each head may be readily raised and lowered by means of a rack and pinion. An adjustable stop is provided which may be clamped on the column face in order that the sliding head may be brought back quickly to exactly the same place each time the head is raised, a most desirable feature.



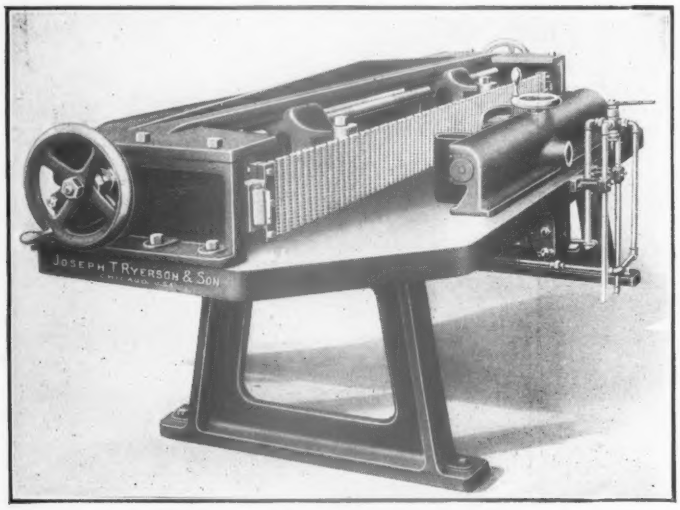
Gang Drill With Spindles Having Lateral Adjustment

A hand lever reverse is ordinarily provided but if desired an automatic reversing mechanism may be furnished. This is desirable for depth tapping; the trip may be set so that the instant the tap reaches the required depth the spindle will automatically reverse, backing out at an increased speed. The shifting lever may be so set that when tripped automatically or by hand, it will return to the neutral position, thus stopping the spindle instantly, instead of reversing it. The machine has a net weight of 9,700 lb.

UNIVERSAL ELLIPTIC SPRING FORMING MACHINE

UNTIL recent years, very little attention was given to the design of spring machinery for use in railroad repair shops. The greater part of the equipment in many shops was home-made and such machines as were available on the market were not designed from the viewpoint of operating the spring repair department as a unit. Joseph T. Ryerson & Son, Chicago, undertook the problem of developing a line of spring machinery specially adapted for railroad shops and with the idea of simplifying and co-ordinating all of the operations to as great an extent as practicable.

The latest addition to this line of spring machines is shown in the illustrations and is known as the Ryerson universal elliptic spring forming machine. It is made in four sizes and will form elliptic spring leaves of any size and curvature used in ordinary practice; it requires but one operator. This work in many railroad shops is now largely done by hand and the possibilities of the new machine in turning out more accurate and more uniform work at a considerably reduced cost are great. The hot spring leaf is formed upon a cold one against which it is to mate, thus giving it accurate camber and fit. A second heat for tempering is unnecessary as the leaf may be quickly passed from the machine to the tempering bath. The machine, when properly operated, will form leaves free from twisting or warping and will straighten out any twist that may be present in the original bar.



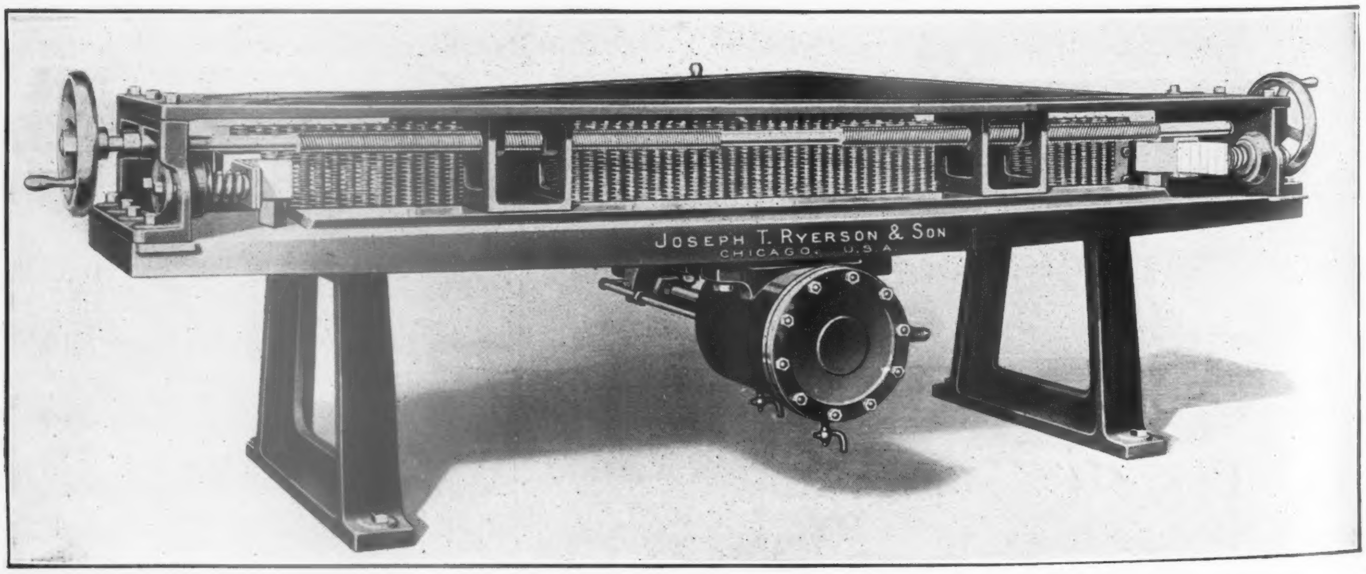
Elliptic Spring Forming Machine

One road which has installed a machine of this type was asked by the *Railway Mechanical Engineer* as to the results which had been obtained. Extracts from the report follow:

"Springs made by this method give more than triple the length of service compared with springs constructed by previous methods used in our shops. This means more continuous service from the locomotives so equipped because of less frequent spring renewals, less wear and deterioration to the locomotive because of the use of better springs, and a saving of wear to the track. All of this is reflected in increased mileage of the locomotives. The improvement is presumably due to the fact that the leaves are made more rapidly, at lower temperatures, permitting them to go to the spring baths at more uniform temperatures, and that the plates are fitted together more accurately so that each does its proper proportion of the work.

"The springs are not going back to the spring shop for repairs as frequently as they did formerly; for instance, a tye of spring used on a heavy Pacific locomotive was given careful study. An average of 38 of these springs were being made each month before the introduction of the spring forming machine. After the machine was introduced, the rate of manufacture of these springs dropped until it finally reached four per month, indicating conclusively the greater length of life due to the new method. It does not overstate the fact to say that springs made by this method have an increased life three times that of springs made by the best methods previously used."

The machines range in weight from 3,250 lb. for the smallest size to 4,000 lb. for the largest one. A special foundation is not necessary with this comparatively light weight, particularly since the machines are free from vibration in operation. What is known as the crosshead former is operated back and forth on the table by means of compressed air or hydraulic power through the cylinder attached underneath the table. The plunger is connected to the lower end of a vertical slide lever, the upper end of which is attached to the crosshead former. This provides for a maximum stroke of the former of 10¾ in. The three-way valve,



Rear View of Elliptic Spring Forming Machine

which controls the operation, is conveniently located for the operator.

There are three projections on the inner side of the crosshead former; the two outer ones are adjustable lengthwise to suit the length of the spring leaf and the central one may be adjusted crosswise with the table to suit the curvature of the leaf. The adjustments to suit the different leaves may be made quickly by means of a hand wheel.

In actual operation the cold leaf, against which the new one is to be formed, is placed next to the crosshead former and the hot leaf is placed just inside of it, the leaves being centered by nibs. When pressure is applied, the crosshead former forces the hot leaf against a metal chain forming band which rests on edge on the table top and is securely held in position by a double set of springs which furnish the necessary resistance to forming the spring plates. Directly back of the chain forming band is a set of what are designated as "laterally adjustable lengthening anvils." These anvils or formers may be adjusted lengthwise with the table by means of hand wheels at each end of the machine and provide means for lengthening or shortening the effective length of the metal chain to accommodate any length of spring plate and to form perfect contact at each end of the plate. They are quite clearly shown in the rear view.

After the newly formed leaf has been dipped in the tempering bath and cooled, it is used as the cold plate for forming the next leaf, this being done successively until a full set of leaves is built up, after which they are assembled and banded. To provide the necessary camber for the hot leaf, the adjustable dies on the crosshead former are set to spring the cold template the desired amount, thus causing the radius of curvature of the new leaf to be reduced sufficiently to provide the desired camber.

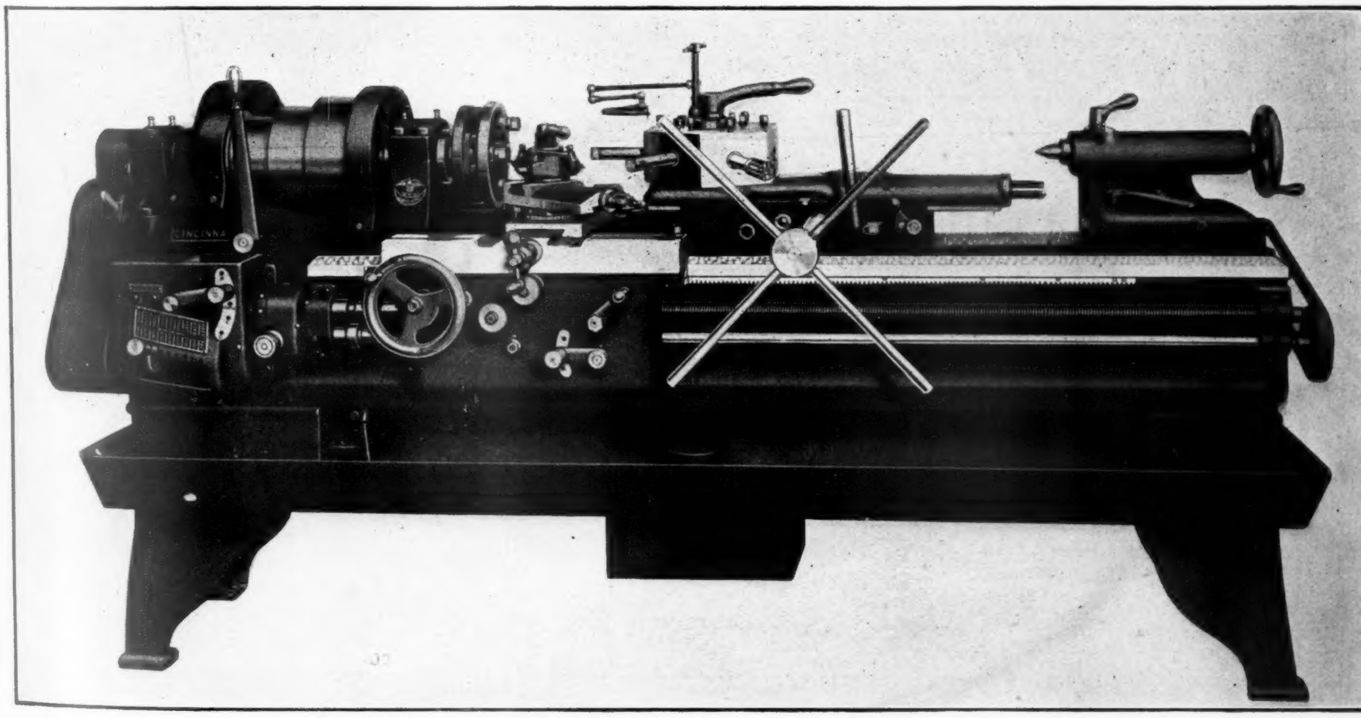
The four sizes of machines differ principally as to the length of the table, this being such as to provide capacities for four sizes of spring leaves as follows: 5/8 in. x 7 in. x 60 in., 5/8 in. x 7 in. x 72 in., 5/8 in. x 7 in. x 84 in., and 5/8 in. x 7 in. x 96 in. The floor space required varies from 4 ft. x 9 ft. 6 in. for the smallest size to 4 ft. x 12 ft. 6 in. for the largest one.

CONVERTIBLE HEAVY ENGINE AND TURRET LATHE

CIRCUMSTANCES frequently arise in railroad shops where a heavy production turret lathe is called upon to perform somewhat spasmodically. It may stand idle for a period during which an expected order for 100 or 1,000 pieces, all of one kind, is not forthcoming, thus putting the "quantity producer" on a more or less non-dividend paying basis in proportion to the time it may actually be inoperative.

A suggested reliever of situations of this kind is offered in the design and construction of the severe duty engine lathe shown in the illustration, which provides all of the advantages of a heavy all-round engine lathe and at the same time can be quickly rigged up for quantity production by the attachment of a quick-acting hexagonal turret on the lathe bed and a turret tool holder on the cross slide.

These lathes are all constructed to permit the addition of a taper attachment which is mounted on the carriage and has a long bearing on the lower side, insuring accuracy. Graduated on one end in degrees and on the opposite end in inches, this accessory will accommodate work up to 12 in. long in one setting and turn up to 10 deg. and 4-in. tapers per foot. This lathe is the product of the Cincinnati Lathe & Tool Company, Oakley, Cincinnati, Ohio, and is made in sizes from 16 in. to 28 in., inclusive, in either cone type belt drive, or geared head for belt or motor drive, with 2-ft. variations in length of bed from 6 ft. to 20 ft.



Cincinnati Standard Engine Lathe With Quick-Acting Hexagonal Turret.

The headstock is made in three styles—four-step cone, single back gear; wide three-step cone, double back gears; and double friction back gears. The spindle, of high carbon forged steel, has a collar at the nose end supplying a stiff

bearing when chucks and plates are attached. The thrust bearing at the rear end of the spindle provides a hardened tool steel collar for adjusting the wear; the end thrust is taken against the front end of the rear box.

The apron is of box type construction, giving a double support to all shafts and studs mounted in it, and providing for accuracy as well as long life of all the working parts. The rack pinion is made of steel, well supported close to the rack on the bed, and motion to it is transmitted by compound gearing. Longitudinal and cross friction feeds can be started, stopped or reversed while the lathe is running, but cannot be engaged when cutting screws. A thread chasing dial is provided, which permits the half nuts to be opened, the carriage to be run back by hand and the thread to be caught or picked up at any point without reversing the lathe, so that a backing belt is unnecessary. The machine is also provided with an automatic stop.

The reverse plate for cutting right and left hand threads is on the outside of the headstock and is used only for reversing the lead screw when cutting threads and not for reversing the feed. These machines have feed reverse in the apron. A device with a quadrant permits a combination of extra or metric pitches with U. S. standard lead screw, or vice versa, besides those obtained in the gear box.

The screw cutting and feed mechanism is characterized by its simplicity, compactness, ease of manipulation and strength. Changes from one standard thread to another can be made at once without duplicating or removing a gear, by simply operating two levers conveniently placed a few inches apart. The index plates are so placed on the box that the operator will know at a glance the correct setting for any thread or feed.

The tailstock is of the offset type, which allows a compound rest to be set in a plane parallel with the bed.

TWENTY-INCH AUTOMATIC TURRET LATHE

NOT a few railroads now have manufacturing departments in their larger shops for quantity production of small standard parts. The automatic turret lathe occupies a prominent place in such departments.

The 20-in. automatic turret lathe shown in the illustrations has been designed to be convenient in adjustment, rigid and powerful in use, and all of its motions and operations are automatic except the insertion and removal of the work; even the automatic removal of work may be accomplished on some pieces if an air chuck is used. It has turret feeds ranging from .003 in. to .333 in. and cross slide feeds ranging from .0015 in. to .166 in. per revolution of the spindle.

Safety to the operator has been given special attention. The gears have been covered and all revolving parts protected. Dangerous projecting parts have been eliminated. and the turret has been designed to turn toward the front, instead of in the usual way, so as to protect the operator and avoid the danger of the tools catching him and drawing him against the machine. The lathe has an over-all length of practically 12 ft., with a maximum distance from chuck to turret of 48 in. It is built for either belt or motor drive by the Gisholt Machine Company, Madison, Wis.

When the shape of the work permits, it is possible to arrange the chuck jaws so that, after the piece has been finished on one side, it may be reversed in the chuck by the operator and the other side finished with tools mounted on the remaining faces of the turret.

Either standard 18 in. scroll chucks, or air chucks may be used with these machines. When an air chuck is used, the pressure is automatically controlled by a valve operated by a dial below the pulley shield, so that in taking roughing cuts a maximum air pressure of about 80 lb. or 90 lb. is used, but when taking light finishing cuts, this pressure is reduced to 20 lb. or 30 lb., to relieve the strain and prevent distortion of the part that is being finished. The dial mentioned above also automatically controls the electric signal,

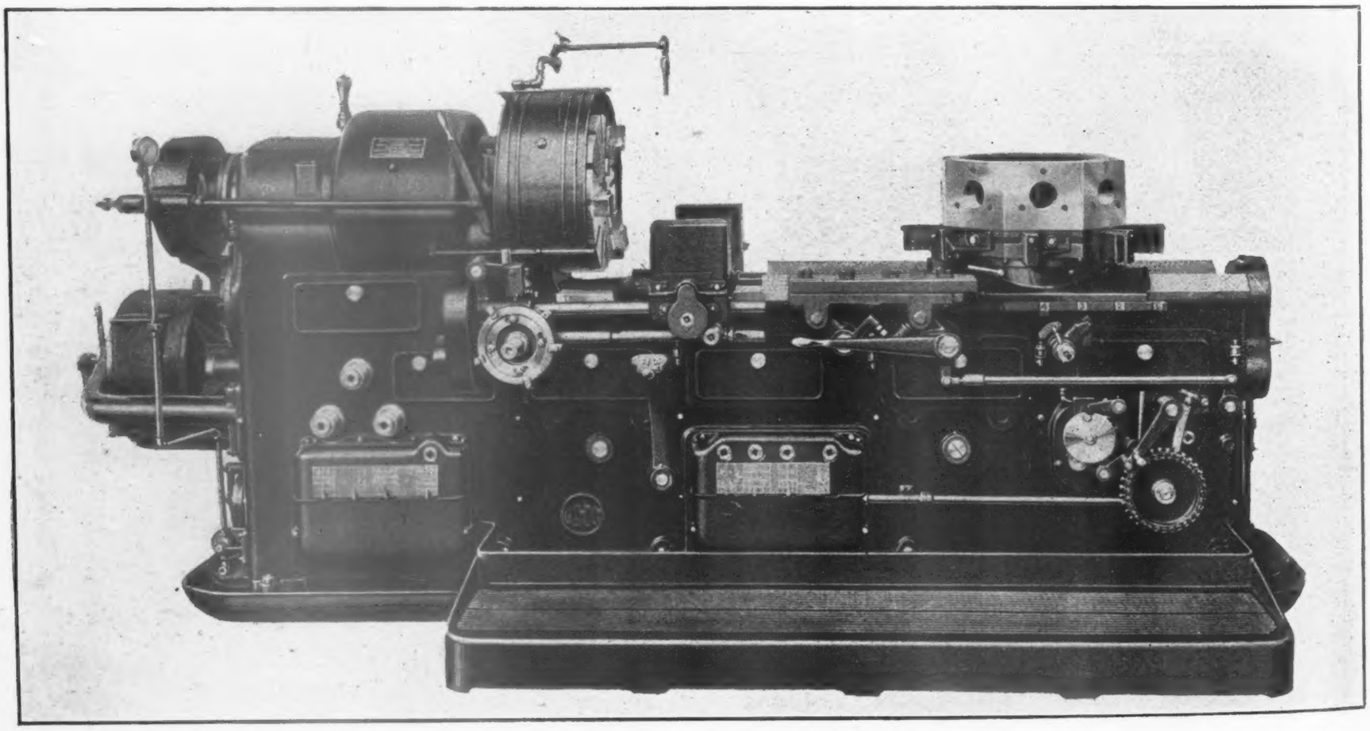


Fig. 1. 20-in. Gisholt Automatic Turret Lathe

which notifies the operator when the piece is completed. The air cylinder is operated in either direction, by a lever conveniently located, and is adapted for either internal or external chucking, without any adjustment of cylinder or chuck, except the provision of proper top jaws on the chuck

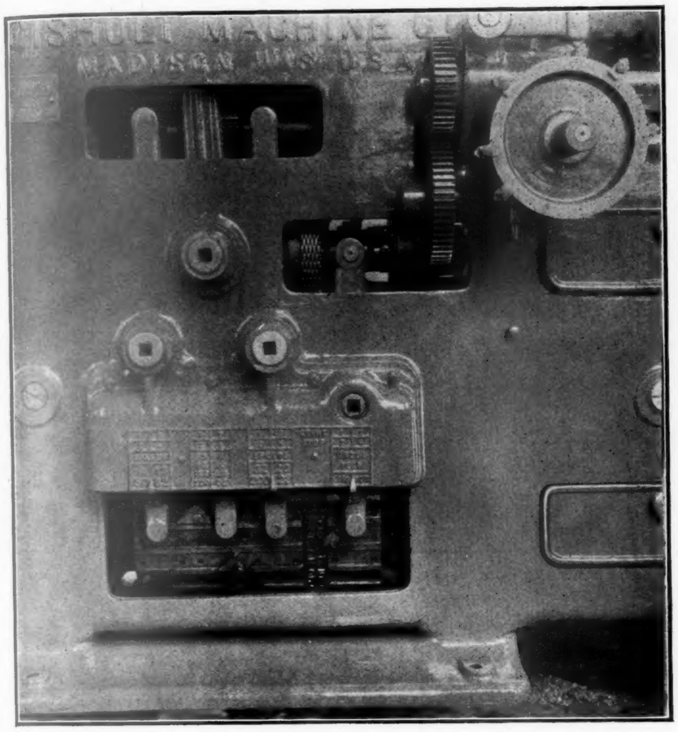


Fig. 2. **Drum Blocks Which Control the Spindle Speeds**

cross feed screw, lead screw and the like, are provided with jaw bases. A positive spindle brake is provided for the convenience and safety of the operator when chucking.

The machine, as a whole, is constructed on the unit principle. The main driving shaft runs from end to end. All

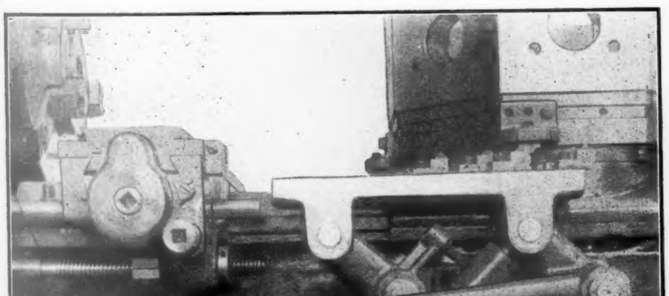


Fig. 3. **Drum Blocks Which Control the Feeds and the Traverse Movement of the Turret and the Cross Slide**

shafts for headstock and turret-drum levers, as well as the square socket holes, of uniform size, so that one hand crank can be used for convenience in setting up for a job.

The spindle bearings have ring oilers and all fast running shafts have sight-feed oilers. There are four changes of spindle speeds running in geometric progression. All spindle speeds are obtained through friction clutches by the operation of two levers, automatically controlled by blocks on a drum underneath the headstock, as shown in Fig. 2. By the use of these blocks, with the assistance of the pointers

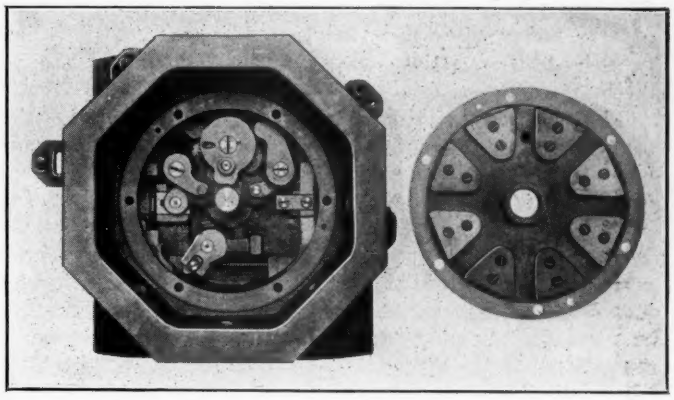


Fig. 4. Inside of Turret Indexing Mechanism

and speed tables shown, the shifting levers are easily set for any available speed.

Thirty-three feeds obtained by change gears are available for feeding the cross slide in or out, or for feeding the turret forward. The independent trip blocks for the in and out cross feed, are shown on the dial under and a little to the

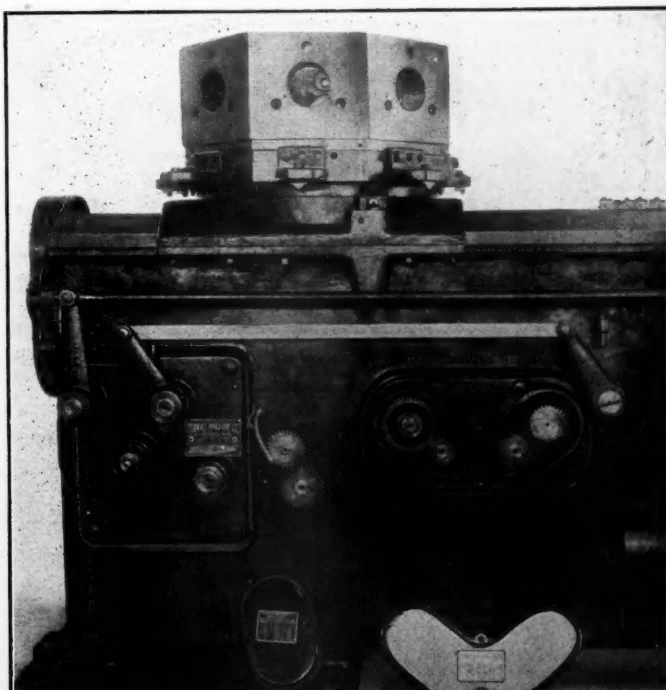


Fig. 5. Rear View Showing Covers Removed from Change Gears

left of chuck in Fig. 1. Rapid traverse movement in either direction for the cross slide and turret are also provided. The feeds provided are suitable for roughing, finishing, reaming and facing. Any feed is available for the tools on any face of the turret, or for either the front or back tool block on the cross-slide by applying the proper drum blocks on

the drum shown in Fig. 3. These drum blocks also control the traverse movement of the turret and cross slide.

The turret has independent trip blocks for each face, which strike blocks on a trip table, as shown in Fig. 1. This photograph also shows the convenient position of the hand-tripping lever, just below the trip table.

The headstock and turret drums referred to, are provided with 31 spaces, making 30 changes possible, with one space for starting. When all the spaces are not to be used the front row of studs on the outer diameter of the index dial rim which is shown near the lower right-hand corner of Fig. 1 causes the drum shaft to be brought rapidly back to zero, or the starting point, for the chucking of the next piece.

The rear row of studs on the outer diameter of the index dial rim is used to set the timer in motion, the speed of which is controlled by gears interchangeable with the feed change gears. These change gears give the timer a speed of from 2.9 to 6.4 revolutions per one revolution of the spindle. The purpose of the timer is to give a "clean up" or "dwell" period for any feed of the turret or cross slide for any predetermined number of spindle revolutions. It may also be used for stopping any feed after a certain number of revolutions of the spindle. After completing a "dwell" or "feed period" the timer automatically trips the machine for the next operation. The timer dial is shown in Fig. 1 a little above and to the left of the index dial.

The row of studs on the side of the index dial next to the bed of the machine is used for setting the brake on the turret lead screw during a "dwell" or "clean up" cut, thus preventing the tool from being forced away from the work.

A desirable feature, to which attention should be directed, is the easy removal of the "index dial," "cross feed dial," and the "turret stop table," with all stops assembled. This feature makes the "setting up" of various jobs on the same machine very convenient in that it preserves the relative positions of all the stops for any particular job.

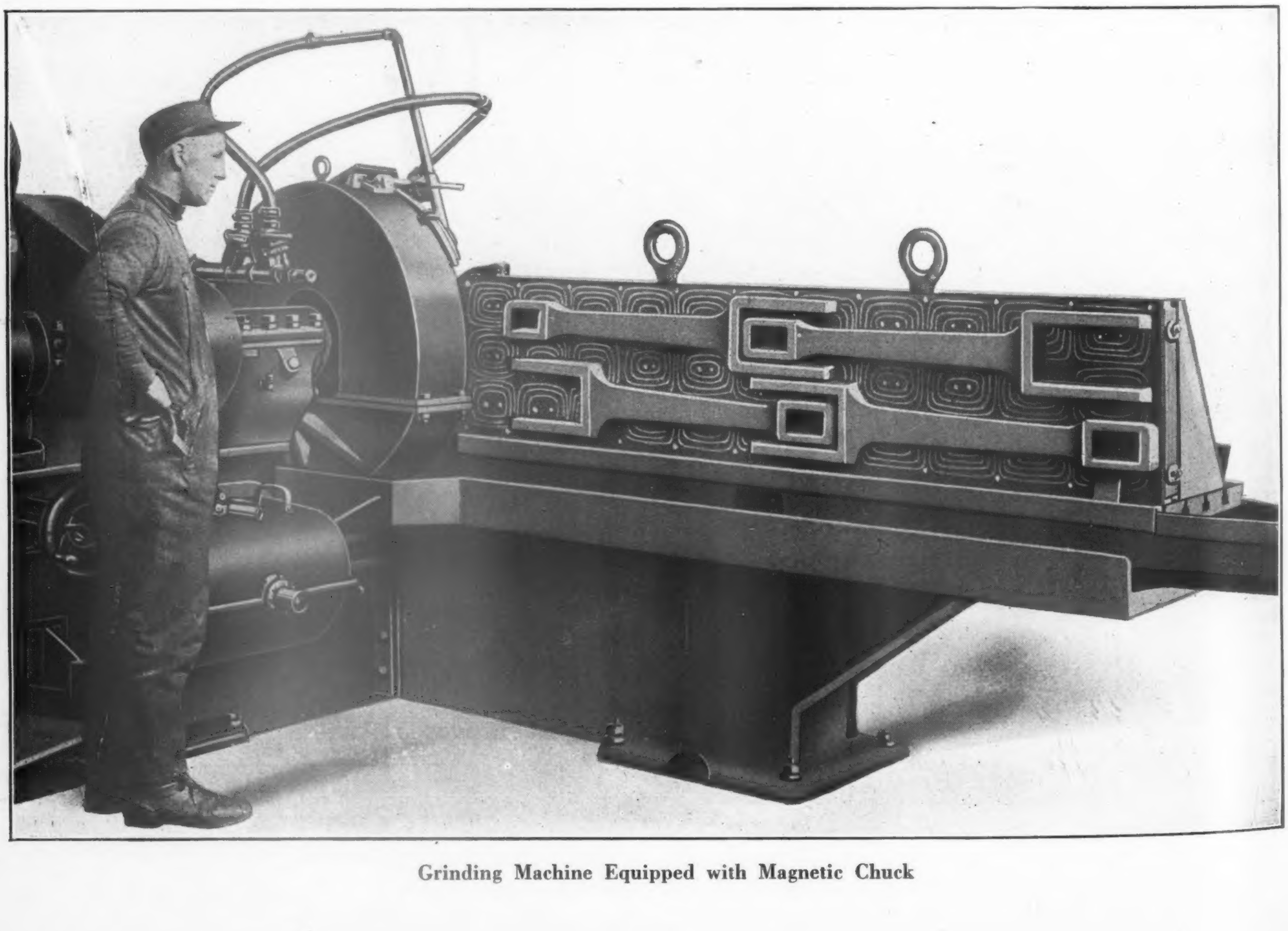
The inside of the turret indexing mechanism is shown in Fig. 4. In order to expose the indexing and locking mechanism the top plate is shown removed and placed bottom side up to the right of the turret. From this it will be seen that the turret is revolved by a crank movement, a roller on the end of the crank working in the spaces between the blocks which are doweled and screwed to the bottom of the turret as shown.

In order to give an idea of the placing of the change gears a part of the back of the machine is shown in Fig. 5, with the gear covers removed. The gears are easily slipped off or on by hand.

CUTTING DOWN THE CHUCKING TIME

IN keeping with the steady progress in the use of the individual electric motor drive for machine tools in railroad shops, the acquisition of electrically operated accessories and small tools is receiving much consideration. The large magnetic chuck shown in the photograph is offered as a suggestion in the chucking of parts for face grinding.

The face of the chuck is 18 in. by 84 in. and is shown in operation bolted to the bed of a heavy duty face grinding machine manufactured by the Diamond Machine Company, Providence, R. I. The four connecting rods are being ground

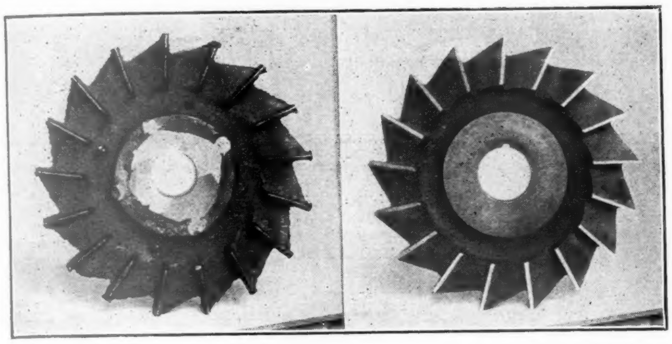


Grinding Machine Equipped with Magnetic Chuck

from the rough without any previous machining. The question immediately arises as to how the work is held magnetically in view of the unevenness consequent to the rough forging, and in view of the fact that at the start of the work the links will not be held by a smooth surface. The answer is that a very light cut is taken from the surfaces in the rough and then the links are turned over so that the fairly smooth surface is against the magnetic face.

REMARKABLE DEVELOPMENT OF CAST TOOL STEEL

The perfection of a method of casting all-but-finished machine tools devoid of blow holes, crystallization, or strains, providing a homogeneous casting throughout with remarkable metal removing ability, seems to have been successfully achieved. A varied collection of steel tools and tool steel, manufactured under the Davidson process of casting formed tools, will be exhibited at the June mechanical conventions in Atlantic City by the exclusive distributor for the railroads in the United States, Oscar F. Ostby & Co., Inc., New York.



(Left) Rough Casting of Milling Cutter. (Right) Finished Cutter.

The story of the development of the process by Arthur C. Davidson, president of the Davidson Tool Manufacturing Corporation, New York, who has had a wide experience in the production and heat treatment of tools for different purposes, is a romance in steel making interrupted by discouragements, disappointments, accidents and the usual setbacks incident to the development of any revolutionary process.

In April, 1918, Mr. Davidson had no works of his own and it was necessary to rent a furnace which had at one time been used for making crucible castings, but which had been out of use for some months. This furnace was of poor design and in a bad state of repair, but it was thought that it would serve for a demonstration heat. Ten 100-lb. crucibles were accordingly charged and put into the furnace, one of which was charged entirely with high speed steel scrap, largely that resulting from previous melts made by Mr. Davidson. This was done to prove whether or not the gates and risers resulting from the casting operation, could be worked up in subsequent heats, with the object of gaging the value of the process if these had to be thrown away.

The furnace worked so badly that the heat instead of coming out in six hours, as it should have done, was in the furnace about ten hours, and only three pots became hot enough to pour at all, the metal even from these being entirely too dull for the best results. After this number had been poured, the cover over the furnace flue collapsed and the heat had to be terminated. The conditions surrounding the test were therefore in every way unfavorable and disadvantageous. Nevertheless a number of milling cutters, countersinks for ship rivets, and forming tools were cast, some of the best of them coming from the pot charged entirely with scrap. Two of the cutters and one of the countersinks were taken from the works, etched with private identification marks, turned back to Mr. Davidson for annealing, machining, hardening and grinding and were then tested. In order to have a fair standard of comparison, a side milling cutter of one of the best brands of high speed steel was bought directly from the works. The tests were made at the Quintard Iron Works, and although it was by no means a perfect casting, nevertheless it stood up favorably against the stock cutter under the most extreme test that could be given it.

A 2½-in. by ½-in. side milling cutter of the cast steel was then put in the machine and tested at gradually increasing speeds until finally the limit of the machine was reached. The cutter was taking a depth cut similar to a keyseat in a bar of steel of 0.30 or 0.40 per cent carbon, this cut being the width of the cutter by ¼ in. deep. On the final test, the cutter was run at a speed of 400 r.p.m., with a feed of 7 in. per minute. This is a linear cutting speed of about 250 ft. per minute, and, as stated, was the limit of the machine. The cut was run as far as the clamps on the test bar would permit, and as it was not possible to test the cutter any more severely, the trial was stopped, the cutter taken out, and it showed no sign of the gruelling test.

In spite of the fact that the casting conditions were bad, the results of the test seemed to indicate the probability that tools could be produced by this process free from blow holes and sufficiently true to form to be finished merely by grinding the cutting edges.

The structure of the steel appeared to be so good and the tests were so satisfactory that Mr. Davidson was advised to proceed with the commercial development of the process, and accordingly a small foundry was obtained in Brooklyn, N. Y., a crucible furnace built, molding machines, and machine tools for finishing or partially finishing the product installed, and production, which was started in August, has proceeded regularly ever since. An electric furnace has since been installed for melting the steel.

For convenience of comparison, an ordinary milling cutter, just as it comes from the mold, is shown in the illustration; adjoining it is shown the same cutter, ground and finished and ready for work. It will be noted that the milling cutters are cast with a projecting lip on the cutting edges; these are finished entirely by grinding and with little more expense than the grinding of a machine tool. A perfect edge is obtained in this way with a minimum of labor and lost steel, while the possibility of local defects is avoided.

The material used for "killing" the steel during the casting process is a secret; it may be said, however, that the results are striking in the last degree, and the metal, instead of having a comparatively sopey pour, is thin and fluid, more like good hot cast iron than like steel. As a result the details of small cutters are cast practically perfect.

It is well known that most steel, when cast, has a coarsely crystalline structure, but an examination of the fresh fractures of Davidsonized steel shows that this is almost wholly absent; in fact, the structure of this steel, as cast, looks more like that of forged steel than it does like a casting.

Davidsonized high speed steel milling cutters have machined chrome vanadium *D* type, showing scleroscopic reading of 40 points at 98 ft. per minute, depth of cut ⅜ in. and a feed of 6 in. per minute. They ran continually without grinding for six hours, after which it was only necessary to stone up the edges, after which they were run under the same conditions for eight hours. The teeth then required grinding of .005 in. off the diameter.

UTILITY STEAM OR COMPRESSED AIR HAMMER

WHAT is known as a 30-in. Cincinnati special forge operated either with compressed air or steam, has been developed by the Sullivan Machinery Company, Chicago, Ill., for such work as the making of chisels, wrenches, small tools of all kinds, small levers, keys and wedges, etc. It may also be used for welding and straightening rods and bolts, or for the sharpening of picks and crowbars, or similar jobs. An important advantage is its rapidity of action which is made possible by the use of an air or steam thrown valve; a maximum speed of 600 strokes per minute is possible.

The guide block is bolted to the rigid cast iron frame and supports a small vertical engine, as shown in the photograph. The small pin which is shown projecting from the lower end of the valve chest is held up, when the machine is not in operation, by the levers which are operated by the foot treadle. The upper part of the pin projects into the valve chest and abuts against the lower end of a floating valve. When the treadle is depressed, the end of the lever drops away from the pin and allows it to fall away from the valve. This uncovers the ports and the valve starts operating, and the hammer begins to strike. A single blow may be struck or many in succession, either light or heavy, at the will of the operator. The operation of the valve is similar to that of a rock drill valve; indeed, the hammer part of the machine is a Sullivan FF-12 rock drill.

Since the travel of the foot treadle is long as compared with the travel of the valve, the operator can feel out the action of the valve and closely and accurately control the action of the hammer. Because of the rapidity of action, the operations may be performed at a moderate heat.

The distance from the center of the die across the throat to the frame is 15 in. Work may be done upon material up to 2 in. in thickness. The hammer cylinder is 2⅝ in. in diameter and has a stroke of 5¾ in. The air consumption at 90 lb. per sq. in. pressure, is 93 cu. ft. per minute. The rebound of the hammer is controlled in such a way that some of the air or steam is held in the upper end of the cylinder, thus cushioning the piston on the return stroke, or rebound, and preventing a jar or jolt to the machine.

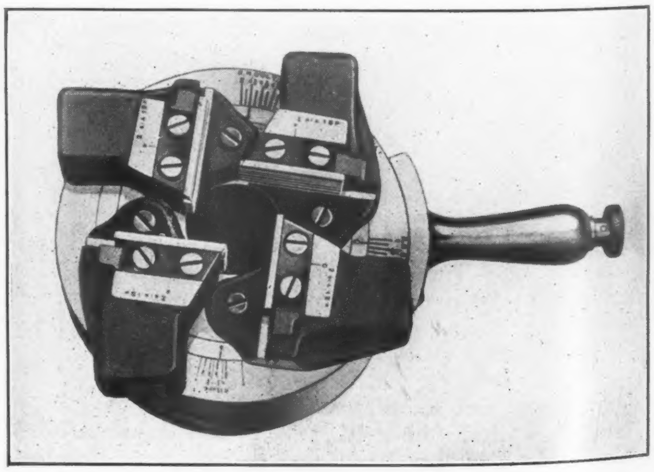
The weight of the striking parts is 100 lb., including 52 lb. for the upper guide, 27½ lb. for the upper die and 19 lb. for the weight of the piston, rings and springs. The machine has a net weight of 1675 lb., a height of 6 ft. 6 in.; the base is 26½ in. wide and 29 in. deep. The use of compressed air in operating the hammer has an important advantage in that the exhaust air may be utilized to blow chips, scale or dirt from the face of the die.

Power Hammer for Small Work

AUTOMATIC SCREW CUTTING DIE HEAD

ACCESSIBILITY is the keynote of the screw cutting die head shown in the photograph. The thread chasers which can be easily and quickly removed for grinding or changing, are supported on the face of the head. The head is opened automatically by retarding the forward motion of the carriage, is closed by hand, and is locked by the operating handle which contains a latch having a tongue milled on the lower end. This tongue is milled off center, thereby permitting of roughing and finishing cuts; to adjust the head for either merely requires a half turn of the latch to suitable graduations.

The head is graduated for all sizes of bolts and pipe, both right and left hand, within its range. It is adjusted to size by means of an adjusting screw which engages the head body. Since the operating, adjusting and closing rings remain in a fixed position when the head is closed, the rotating of the head body within these rings gives the diameters within the range of the head. To set the head for left hand threading,


Landis Automatic Die Head

the screw which locks the latch pin is removed and the latch pin is rotated to the left hand graduation; the locking screw is then replaced and the left hand holders attached.

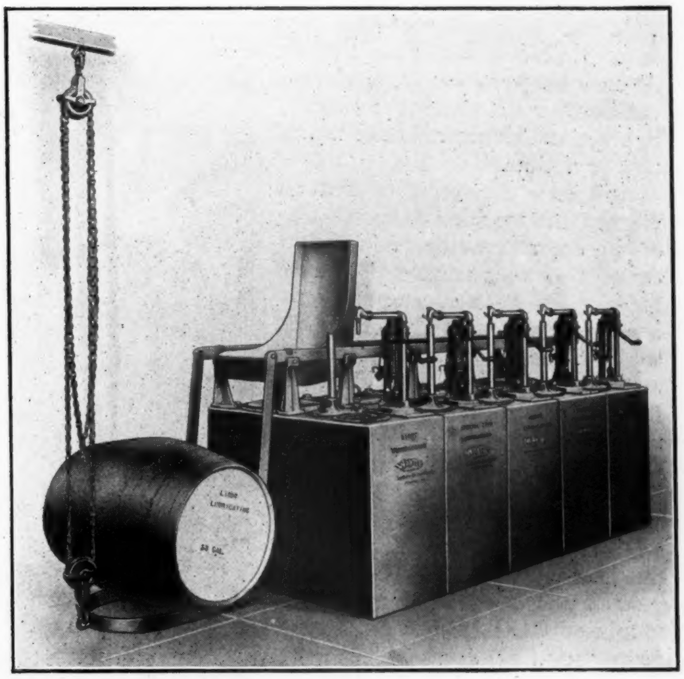
This head which is applicable to practically all makes of screw machines and turret lathes, which have sufficient space to swing heads of these diameters, has been recently designed by the Landis Machine Company, Inc., Waynesboro, Pa., and will be ordinarily furnished with a standard shank. Special shanks may be furnished provided they are not required to be larger than the standard shank.

STORAGE SYSTEMS FOR LUBRICATING OILS

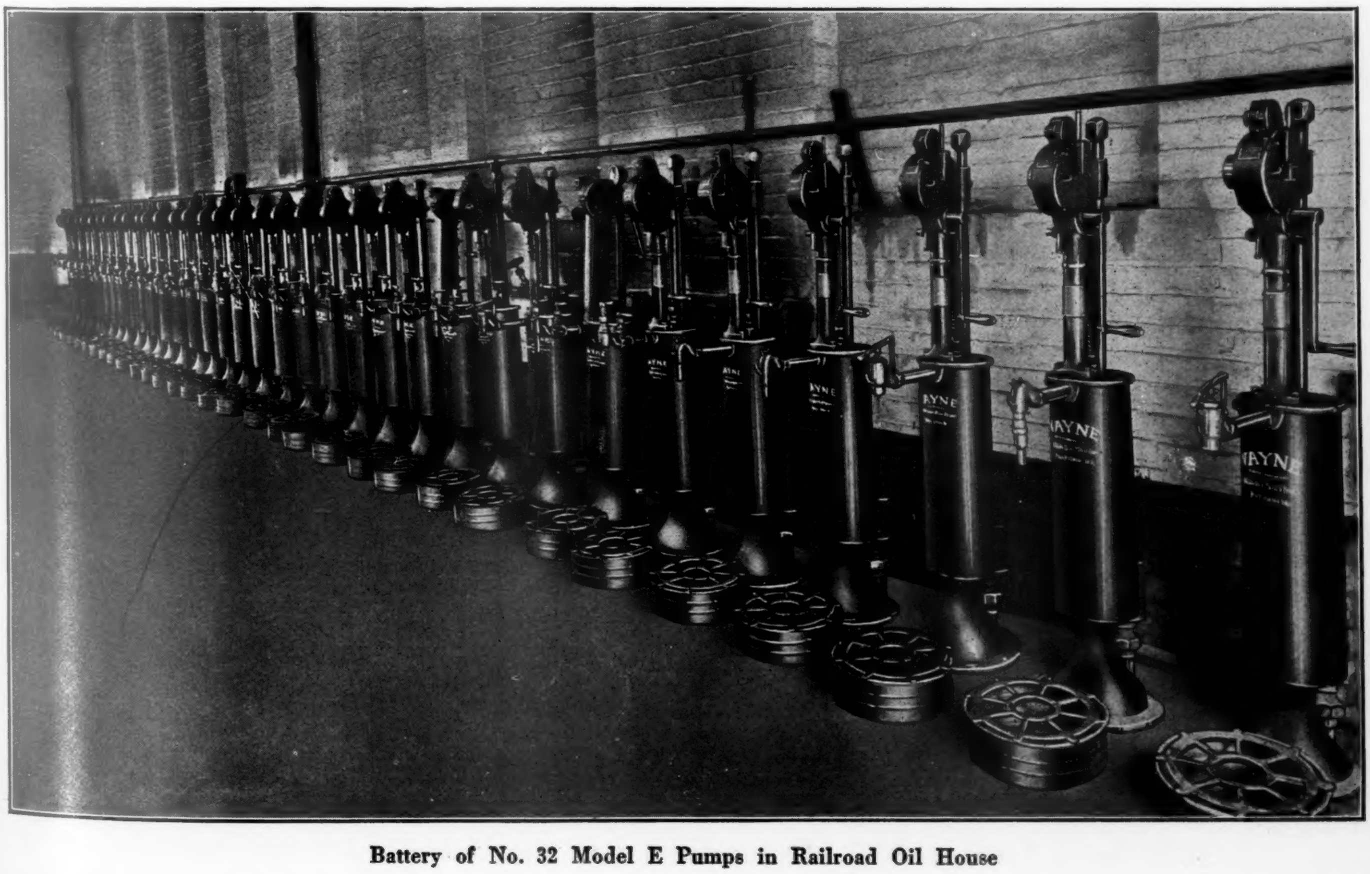
THE battery of oil pumps shown in the photograph is an example of progress which has been made in the orderly arrangement and safe storage of oil.

The battery storage equipment for lubricating oils is illustrative of a system for handling, storing and distributing lubricating oils in a manner which insures the entire draining of the barrels, as well as providing safe storage of the oil in practically fireproof containers free from dust and dirt, with the added advantage of accounting for every gallon used. The tanks are made in capacities of from two barrels up, in batteries formed as shown which can be added to as required, the height and length from the front to the back of the entire battery remaining uniform and the width of each unit across the front varying according to capacity. The equipment may be placed where the liquid is used and the arrangement of the barrel cradle, track and dash affords a means by which the entire contents of either iron drums or wooden barrels may be handled and emptied into storage tanks without waste and with a minimum of labor. Each equipment is fitted with an individual dip gage, providing a check on incoming oil or the contents of the tank. Likewise a measuring pump equipped with pump locks provides a check on all outgoing oil.

The oil storage equipment described is manufactured by the Wayne Oil Tank & Pump Company, Inc., Ft. Wayne, Ind.



Battery Storage Equipment for Lubricating Oils



Battery of No. 32 Model E Pumps in Railroad Oil House

HEAVY DUTY HORIZONTAL MILLING MACHINE

THERE is no clearer index of the growth of the American locomotive than is reflected in the tendencies in the design and construction of special heavy railroad shop tools for machining modern locomotive parts. A conspicuous example of recent improvement along this line is afforded in the new heavy duty horizontal milling machine, designed and built by the Newton Machine Tool Works Company, Inc., Philadelphia, Pa., for the Altoona shops of the Pennsylvania Railroad, upon which the heaviest locomotive driving rods are milled two at a time.

Reference to Fig. 2, a general view of the machine from the rear of the operator's side of the table, conveys at once a general idea of its proportions and strength and reflects credit upon the designer's study of the convenience of its operation in the "easy reach" of all feed and control levers; the driving motor located on the opposite side of the operator and out of his way, and the grouping of lubricating cups for table guides, drive and driving gear, bearings, etc., at the base of the pedestal in plain view of the operator, thus tending to minimize the dangers of damage from "running dry." The strict observance of "safety first" is indicated by the enclosing of all gears.

The base is of the closed top safety type and is one and three quarters times the milling length of the table. Cheeks cast as an integral part of the base for the upright mounting are extended. The uprights are of deep box section carried to the floor line and bolted, keyed and doweled to the base.

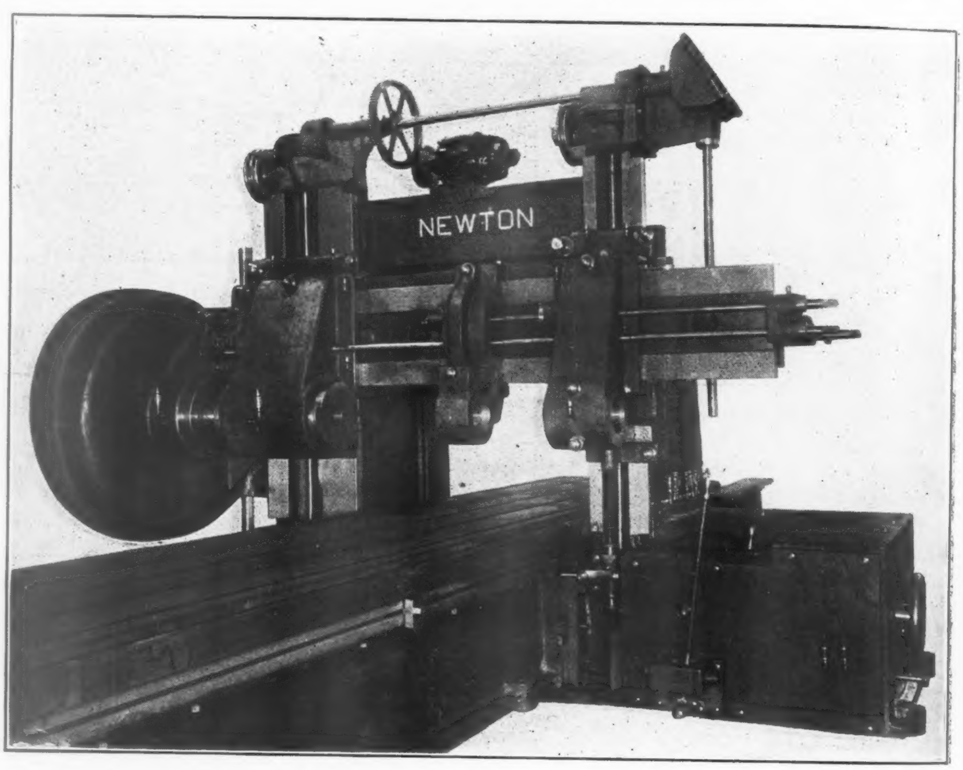


Fig. 1—View from Operator's Position Showing Convenient Location of Control Levers, etc.

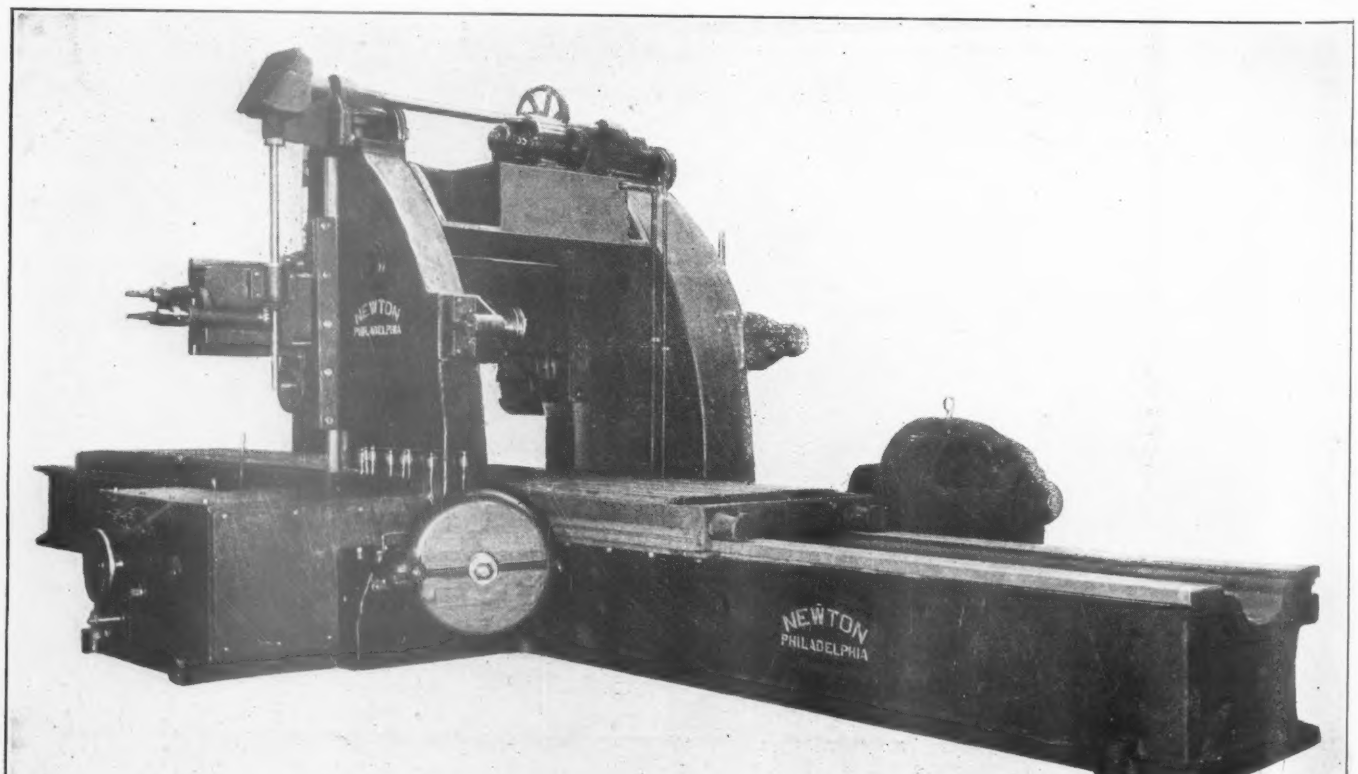


Fig. 2—View of Newton Horizontal Milling Machine from the Rear of the Operator's Side of the Table

The machine is driven by a 75-hp., 400-1,200 r. p. m. motor. Fig. 2 shows the convenience of arrangement of control levers from the operator's position as well as the additional lubricator cups on important spindle bearings and crossrail slides.

The table is supported its full length and has five T-slots planed from the solid with drill stop pin holes at each end. It has a 20-ft. travel, and four changes of speed provided by a steel angular rack and phosphor bronze spiral pinion from a box in which there are mounted adjustable sleeves which give the changes without the removal of gears. An adjustable automatic stop is provided and the table is surrounded by a pan to collect overflow oil which is drained to the reservoir at the base. The rapid traverse and feed clutch are interlocked to prevent simultaneous engagement. The working width of the table is 42 in.; the maximum distance from top of the table to the center of the spindle 31 in., and the minimum distance, 4 in. The width between uprights is 51 in.

The crossrail is of the straight faced type and provides 10 in. of side adjustment to the spindle by a screw from the right hand end of the machine. The crossrail is supplied with one outboard bearing, and one intermediate bearing. The intermediate bearing provides for quick removal with the arbor. The crossrail is counterweighted and has a power rapid traverse in both directions through double lifting screws operated by a separate motor. The 5-hp., 1,150- r. p. m. lifting motor is mounted on the tie beam which also serves as a gravity tank, to which the lubricant is pumped from the reservoir in the base. Hand adjustment is made to the crossrail from the end of the rail. There is a boss on the bottom of the crossrail at the right hand side which, in connection with a gage stop on the upright, is used for gaging heights. The counterweight ropes are of such length as to allow the weights to operate in a pit, and the wheels are so arranged that the ropes follow the contour of the uprights.

The bearings for the driving worm and driving worm wheel are cast integral with the crossrail, and have sliding sleeves for the spindle. The crossrail is gibbed to the main or wide upright only, with the narrow guide construction to assist in maintaining alinement, and is fitted with a continuous steel taper shoe for taking up wear. The crossrail is carried on two lifting screws, which are held in tension at both ends to prevent buckling.

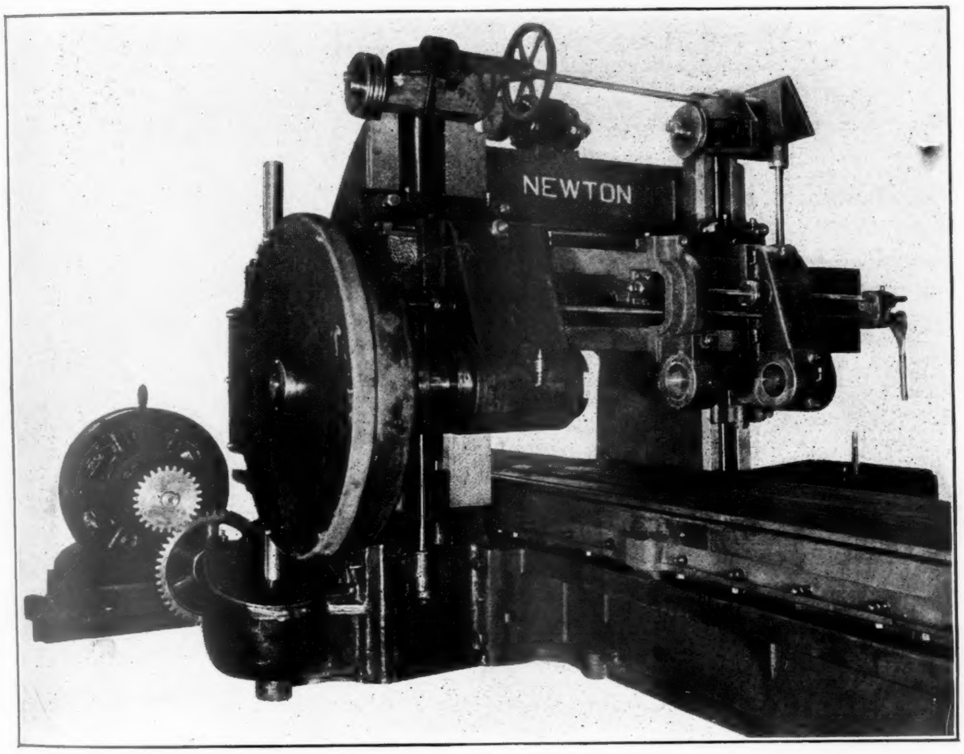


Fig. 3—Showing Application of Motor Drive

The spindle is of taper end construction for taking up wear and maintaining alinement, is provided with an internal taper hole, has a through hole for an arbor retaining bolt, has a broad faced keyway for the cutter arbor, and is bronze bushed throughout. The spindle diameter through the driving worm is 7 in.; the diameter of the large end is 11 in.; it is driven by a phosphor bronze worm wheel and hardened steel worm having roller end thrust bearings, all of which are encased and run in oil. The driving worm shaft is double splined and the bearings in the worm box are protected by sleeves which are keyed to the driving shaft, rotating with it in bronze bushings, so that the keyways do not come in contact with the bearings.

A view from the right hand or motor drive side in front of the spindle is shown in Fig. 3 and gives convincing evidence of the strength of design and construction of the driving part of the machine.

NEW DESIGN OF SET SCREW TOOL HOLDER

A SET screw pattern toolholder has been added by J. H. Williams & Company, Brooklyn, N. Y., to their line of Agrippa toolholders. It is made with both the right and left hand offset and straight shanks. Where the cutter fastening device is in the shape of a cam the range of contact is limited. The set screw fastening has been provided for use where the steel used in the cutters is not ground to size and varies beyond established limits. The set screws are made of alloy steel, thus insuring strength and toughness. The holders have a bevel on the nose in order that they may be used in close quarters. They are drop forged and are given special heat treatment.

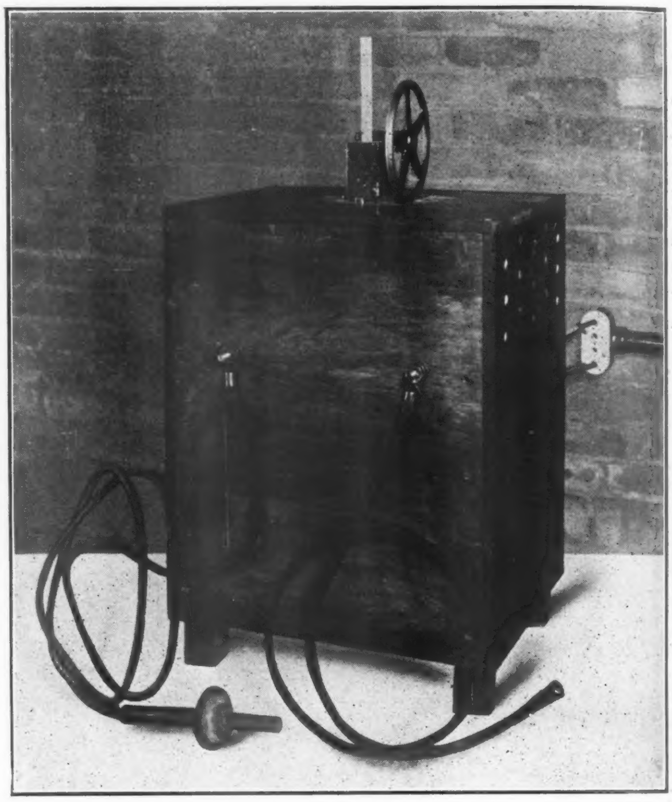
Set Screw Type of Tool Holder

ALTERNATING CURRENT ARC WELDING EQUIPMENT

THE new Zeus arc welder, manufactured by the Gibb Instrument Company, Detroit, Mich., has been designed to overcome the disadvantages of bulk and moving parts which are inherent with all types of motor generator welding apparatus. The new welder consists of a simple transformer with no moving parts. The Zeus welder is comparatively small, making it unnecessary to set aside special space for its accommodation. It is built on the unit system, which makes it possible to connect a duplicate machine in parallel with the original when the work becomes too heavy for a single machine to handle.

One of the outstanding features of the welder is its arrangement for regulation. It is not necessary to change any connection for the purpose of regulating the arc. A hand-wheel is conveniently located on the top of the machine and furnishes a means whereby the secondary winding may be raised and lowered to provide for the regulation necessary for various conditions of work and sizes of electrodes. It is claimed by the manufacturer that the inherent reaction of the transformer automatically stabilizes the arc for different arc lengths and that the current consumption is from 20 to 40 per cent less than that for motor generator welding equipment. It is also claimed that, due to its inherent characteristics, the machine is particularly adaptable to overhead welding.

The particular advantages offered by a welding outfit of this kind lie in the fact that it is portable and that it may be operated from almost any alternating current circuit used for power or lighting. Because of these characteristics, it is frequently possible to use the welder in many places without having special circuits for the purpose.



The Handwheel and Connections Are the Only Exposed Parts

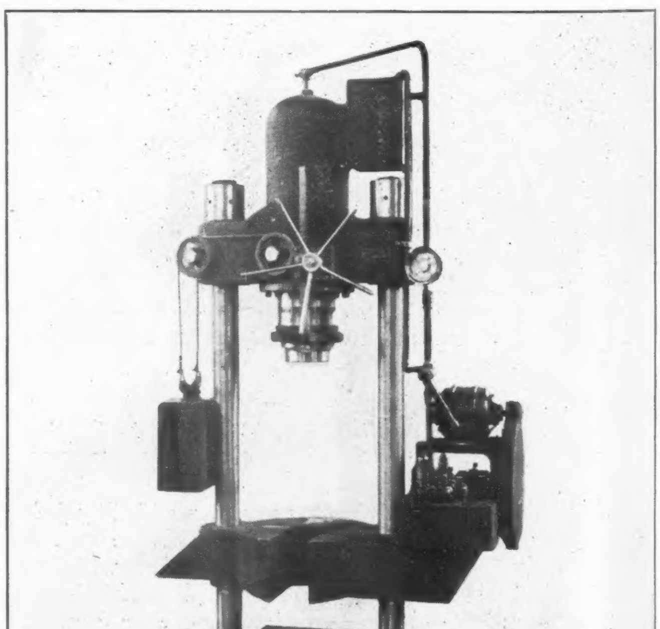
SPECIAL HYDRAULIC PRESS FOR RAILWAY SHOP USE

AN improved type of 200-ton hydraulic forcing press has recently been furnished the Pennsylvania Railroad by the Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio. It is especially designed for the purpose of quickly pressing driving brasses in and out of boxes and piston rods into pistons, and occupies very little floor space.

The bottom base—72 in. from the face of the raised ram—and the cylinder are of cast steel securely mounted on the substantial perpendicular steel uprights or strain rods; they are secured by steel spanner nuts held in place by set screws bearing on copper slugs. The lower base is provided with an 8-in. hole and is designed to stand the effect of full force of the press. The intermediate base, which is 45 in. from the face of the ram, is held in position by screwed collars through the lugs cast on the base and bearing down against the collars on the strain rods. The intermediate base is also of cast steel and is provided with a U-shaped opening 8 in. wide, through which the driving brasses are intended to fall as they are pressed from the boxes.

The press is furnished complete with pump attached, ready to operate by motor drive as shown, or it may be provided with a belt drive. It is equipped with automatic knock-out valves for maximum pressure, also with spring relief valves. The discharge from the main press cylinder, as the ram is raised, is forced into the surge tank at the top, and any surplus liquid which flows into the surge tank overflows to the pump reservoir.

A part of the stroke of the ram is made without any pressure registering on the gage; this is taken care of by a



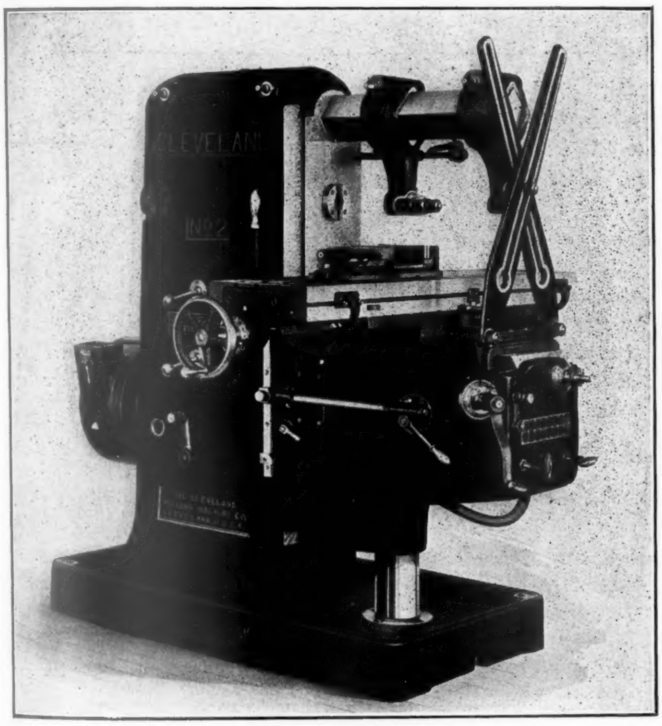
200-Ton Inverted Forcing Press With Two Bases

rack and pinion, so that the ram can be brought down to the work by hand. When this is done the cylinder is filled with water from the surge tank which is bolted to it; the water enters the cylinder from the tank through a check valve. When the ram stops the pump delivers the water to the main press cylinder through another connection and the check valve closes. The ram is counterweighted and will stay in any position where it may be placed.

MILLING MACHINE WITH SPECIAL ATTACHMENT

THE design of the milling machine shown in the illustration is noteworthy in respect to several features, most conspicuous of which is the square overarm and the handy and easily attachable vertical spindle milling attachment, a combination provided to meet the demand of those who, having a certain amount of vertical or face milling work, are unable to keep a vertical milling machine continuously busy. This machine, of the plain and universal types, as well as the vertical milling attachment, are the products of the Cleveland Milling Machine Company, Cleveland, Ohio. The machine is made in two sizes and the following details of construction apply to both models.

The column is of rigid construction—a complete box section—and is cast in one piece with the base, a heavy, ribbed, semi-steel casting, with heavy vertical and horizontal walls, the only openings in which are those necessary for the change gear levers on the front, the pulley drive housing in the rear, and the cutter lubricant tank on the left side of the machine. All of the interior parts are lubricated automatically, and all adjustments on the bearings are made from the outside. The dove-tail knee slide extends upwards to the overarm, affording ample surface for clamping the attachments. The depth of the column has been carefully determined in order to place the spindle and the shaft bearings in proper relation to each other to secure maximum rigidity. The horizontal wall separating the lubricating oil reservoir from that of the cutter cooling compound is designed to give added rigidity to the column; the lower surface of the base is finished so as to give it a firm foundation, while the contour of the upper surface of the base is pan-



Cleveland Plain Milling Machine

shaped with depth enough to catch oil and chips, thus keeping the surroundings clean.

The knee is designed with an improved dove-tail slide and the bearing of the saddle is on the flat, wide surface, the narrow slide acting as a guide only. The bearing of the knee on the column is carried well above the top of the saddle slide, thus giving the knee a longer bearing on the column, reducing the bearing pressure to a minimum. The feed box, as well as the knee, is entirely enclosed. The elevating screw is large in diameter and in one piece. By the use of the post the telescopic screw has been eliminated, as it acts as a support to the elevating nut and as a guide in the knee. The screw is operated with a double bevel gear, the hand feed and power feed being independent of each other.

The table is machined all over to insure proper alinement and the bearings on the table are at the top of the saddle instead of at the bottom of the dove-tail, which method secures a large bearing surface and locates the bearings, which are automatically lubricated by rollers, a greater distance apart. The bearing on the saddle is also at its widest portion, and both saddle and table bearings are taken up with long taper gibs which are provided with adjusting screws at both ends.

The square overarm provides positive alinement of the arbors and maximum rigidity of the arm pendants. It is impossible for the operator to place the arbor supports on the overarm and on the arbor in any other way than exactly in line. Owing to the firmness which the square overarm imparts to the machine a great variety of work can be performed.

The flanged spindle eliminates the overhang on the end of the spindle as well as the trouble caused by cutters screwing fast into it, and also allows the cutter to be run in either direction. On the flanged spindle is a face keyway, inserted into which are hardened steel jaws for driving arbors and face mills. It is unnecessary to remove these at any time to change from a face mill to an arbor, as the driving is done by the hardened steel jaws. The strain is therefore taken off the taper hole. The spindle is provided with a positive lock that enables the operator to loosen the arbor nuts with the least possible difficulty and is also provided with a handwheel to revolve the spindle, which feature the operator will find convenient on boring jobs and other milling operations. The spindle lock cannot be operated while the machine is running, nor can the main driving clutch be thrown in while the spindle is locked.

All the bearings in the column and knee are thoroughly covered with lubricant while the machine is running, thus relieving the operator of the responsibility of oiling the most important parts of the machine and eliminating the necessity of oil holes in any of these parts. The oil reservoir requires refilling but twice during the year. As high speed steel cutters are used almost entirely there has been provided a reservoir of ample size for cutter cooling lubricant, which is circulated by a centrifugal pump operating only when the spindle is in motion.

The speed and feed arrangements are both of the sliding gear type. Changes of speeds as well as feeds are made by two levers conveniently located for the operator. The

spindle speeds are 16 in number, in either direction, and the feeds are 16 in number in either direction also, so that this machine will handle all classes of cutters. Speeds and feeds being in geometrical ratio, the correct changes of speed and feed for the work to be done can be made without trouble. All gears and shafts in the drive, as well as the feed, are of hardened steel, automatically lubricated, running in bronze bearings, and protected against breakage by a safety device.

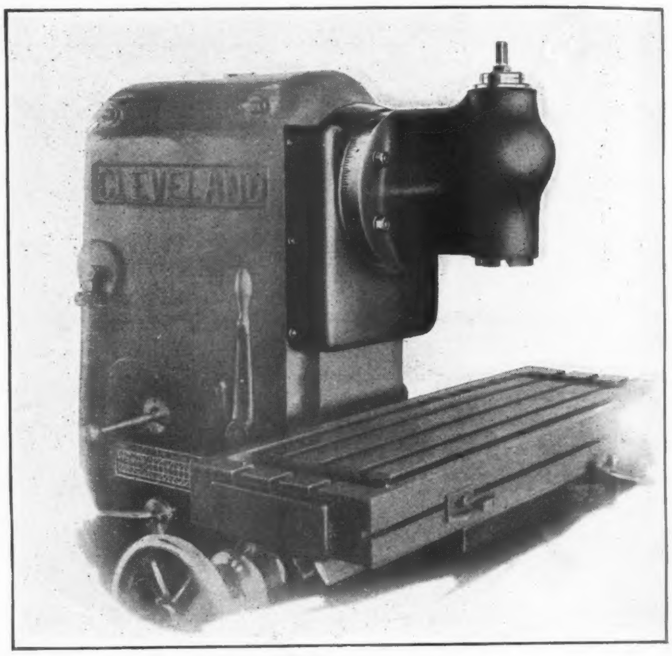
The power is transmitted through a constant speed drive pulley and the machine is so designed that it requires no loose gears on the spindle. All shifting of gears is done on the secondary shafts below the spindle. The starting and stopping lever may be operated from both sides.

The principal dimensions of the smaller machine which occupies a floor space of 70 in. by 60 in., include a table whose working surface provides an area of 44 in. by 12 in. and has three 5/8-in. T-slots and a right and left adjustability of 50 deg. In the larger model, occupying a floor space of 92 in. by 98 in., the table swivel right or left is the same as that of the smaller machine, while the working surface is 50 in. by 13 in.

The smaller size has a longitudinal range of 22 in., a cross range of 8 in. and a vertical range of 15 in., while the larger type has 28 in., 10 in. and 15 in. ranges, respectively. The overarm is 3 1/4 in. square on the small size and 3 3/4 in. on the large; the motors recommended are 5 hp. and 7 hp., respectively.

The vertical spindle milling attachment referred to is shown in one of the photographs. It is bolted to the column and ready for action and is manufactured in three sizes, the distances from the face of the column to the center of the vertical spindle being 10 3/4 in., 12 1/2 in. and 15 in., respectively. The minimum distances from the nose of the spindle to the table are 1 1/4 in., 1 1/2 in., and 2 in., and the maximum 16 1/2 in., 16 1/2 in. and 18 in., respectively. The spindle taper holes are No. 10, 11 and 12 Brown & Sharpe and the shipping weights range from 225 lb. to 415 lb.

The drive is taken from a gear fastened to the nose of the spindle, which drives a spur gear on the horizontal shaft and the spindle is in turn driven by a large mitre gear. All gears and shafts are made of steel and enclosed, running in bronze bearings throughout. The bearings on the spindle are the same as the milling machine spindle and form two



Vertical Spindle Milling Attachment

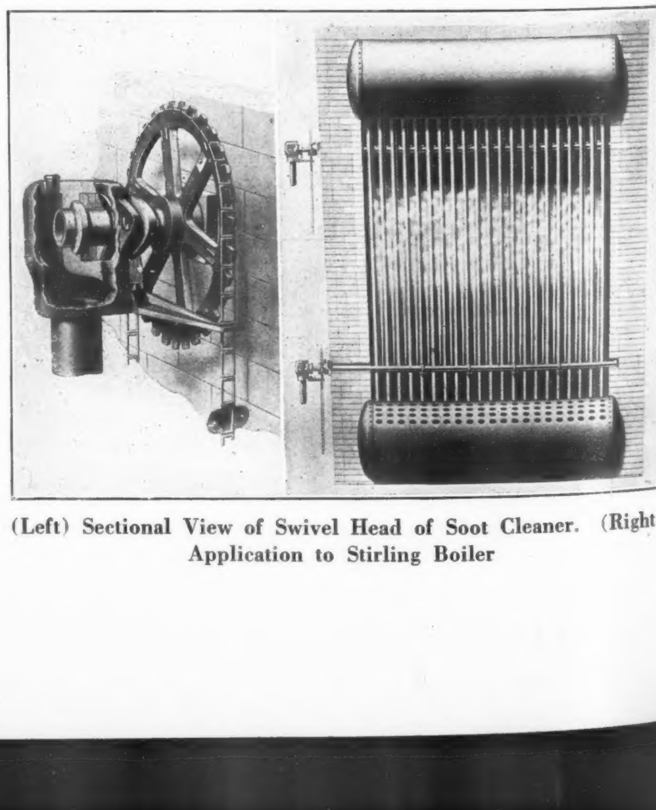
taper cones in opposite directions, adjusted by a nut on the outside of the spindle. The base of the head is graduated so that it may be set at any angle in a vertical plane parallel with the elevating screw, and the attachment when clamped in position on the dove-tail slide of the column which extends above the center line of the spindle, is as rigid as if it were a part of the milling machine.

AN AIR TIGHT SOOT CLEANER SWIVEL HEAD

An improved soot cleaner swivel head which provides for easy and convenient operation, and does not leak steam or permit air infiltration is shown in one of the illustrations with a part of the swivel head cut away to show the relation between the steam delivered to the swivel head from the vertical riser or pipe, and its entrance into the movable horizontal element or spray pipe. The latter is fitted with steam turbine nozzles through which steam at high velocity is sprayed upon the boiler tubes, thus blowing off soot deposits as the spray pipe is revolved by means of the chain operated sprocket to which it is keyed.

A detail which merits attention is the method of packing the stuffing box in the swivel head. It will be seen that the spray pipe has a collar near its end which fits against metal on one side and the packing on the other. It is designed in such a way that when steam is turned on friction is relieved and turning the element by hand becomes easy. As the vertical riser expands or contracts the swivel head rises or falls, carrying with it the end of the spray pipe. Air infiltration, as the result of this movement, is prevented by the use of an air tight sliding joint between the sprocket wheel and the metal housing, which is mortared into the brickwork.

A typical installation of the Vulcan soot cleaner, which is manufactured by the Vulcan Soot Cleaner Company, Du Bois, Pa., equipped with the new Vulcan swivel heads is also shown and it will be noted that the installation is well anchored in the brick walls, the spray pipe being supported on the tubes at four intermediate points. Convenient stops on the sprocket chain limit the amount of rotation and a pointer on the sprocket wheel indicates direction of sprays.



(Left) Sectional View of Swivel Head of Soot Cleaner. (Right) Application to Stirling Boiler

FOUR-SPINDLE AUTOMATIC SCREW MACHINE

THE improvements in the new automatic turret lathe illustrated herewith, are intended to overcome some of the inaccuracies which often result from mismanagement by relatively incompetent operators. The machines are built in three sizes, the smallest type accommodating stock up to and including ½ in. in diameter, the medium type taking up to and including 1 in. in diameter and the largest size capable of machining metal up to and including 1¼ in. in diameter; an additional model is in prospect for work up to and including 1½ in. in diameter.

An outstanding characteristic of the new lathe lies in its compactness and rigidity of design. A stripped bed is

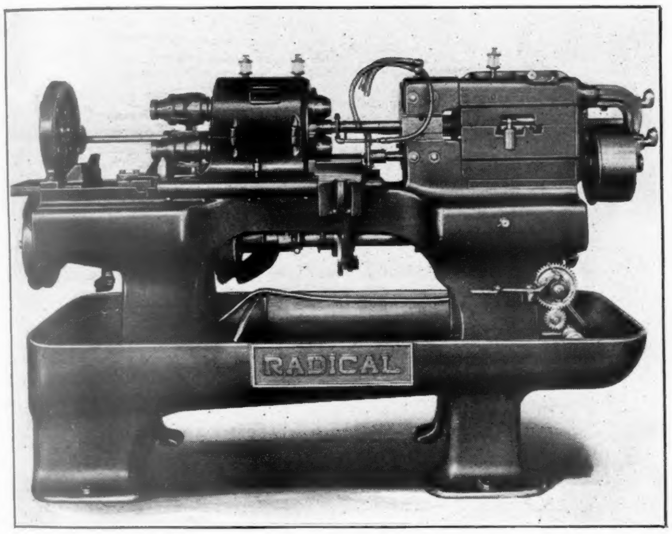


Fig. 1. Radical 4-Spindle Automatic Turret Lathe

shown in Fig. 2 for convenience in illustrating this feature of rigidity and it will be noted that the bed is a solid casting from the bottom of the feet to the top of the tool knee, thus avoiding bolting on of brackets and bosses.

The cylinder and cylinder housing are of semi-steel. The length, diameter and weight of the former compared to the length of the cylinder bearing and of the carriage ways, prevent jumping, tilting or lifting of the cylinder or the carriage. The cylinder carriage movements are to and from the tools to the roll which is held on the bottom of the carriage by a pin. This roll engages the groove on the face of the lead cam, the hub of which is keyed to the cam shaft, which is driven through the cam shaft gear box located on the end of the bed within the pan. Through this gear box the cam shaft is revolved at different speeds to give a fast or slow travel to the carriage as may be required.

The spindles are one-piece steel forgings, heat treated and ground. They run continuously in one direction and are gear driven. Four changes of speed are provided and by removing a split collar and placing it on the opposite side of the driving gear four more changes of spindle speeds may be obtained. The machine provides 10 changes of cam shaft speeds and the eight changes of spindle speeds without pulley change.

Adjustments have been simplified and all adjustable strips on drives eliminated by the use of the so-called "stay-put" cams, one of which is illustrated in Fig. 3.

Ingenuity has been shown in the development of the different mechanisms for controlling the indexing. On the rear of the cylinder is a separate jigged gear which meshes with a pinion gear on the indexing shaft. This pinion gear is keyed to the index shaft and moves forward and backward with the shaft and cylinder carriage travel. As the cylinder carriage reaches its receded position the pinion gear, also keyed to the shaft, meshes with a segment which moves upward by a lever and cam movement. This upward movement is of sufficient duration to give the cylinder a quarter revolution, bringing each one of the spindles in line with the next tool. The connecting rods between the cam and the segment have lock nut adjustment to take care of the wear. The entire mechanism is located at the side of the machine at about the height of the carriage ways. The index shaft carrying the pinion gear extends back to the stock reel frame and on that end carries a pinion gear which meshes with an indexing gear in the reel. In this way the reel is indexed with exactly the same motion as the cylinder, the advantage of which feature lies in doing away with the strain from indexing the reel with bars of stock projecting from the spindles.

The mechanism for locking the cylinder after it has been indexed, is interesting. A hardened and ground bushing fits into a ground hole in the cylinder. A hardened and ground plunger operates through a hardened and ground bushing in its boss, being withdrawn by hand by a lever and automatically by a locking pin cam. The plunger is seated by a spring and is held in position by the cam. The end of the plunger is externally tapered to fit a corresponding taper in the bushing. Provision against wear is made by two additional inside tapers, one in the plunger and one in the bushing; these two sets of tapers check each other at all times. Should either set of tapers become worn, the other set will complete the locking until such a time as the worn set reseats itself. A double throw cam prevents the possibility of any rebound of the plunger from the bushing in the cylinder.

The chuck operating slide and the stock feeding slide are designed to permit of free and positive action for the entire chucking and feeding mechanisms without the use of levers and arms, by using slides which are carefully scraped

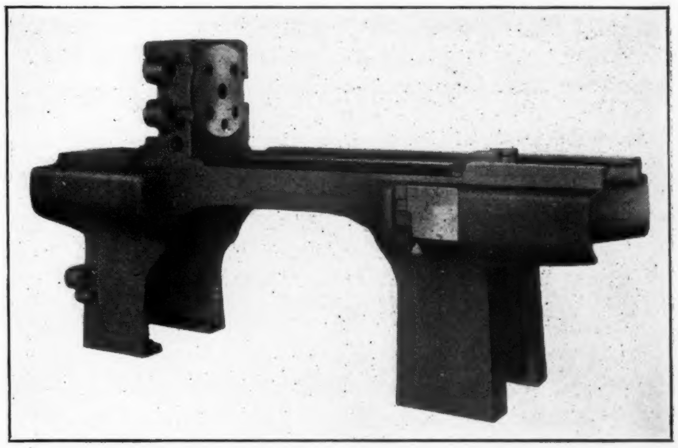


Fig. 2. The Stripped Bed Gives Some Idea of the Rigidity of the Machine

and operate in scraped bearings, the operating, hardened and ground rolls being assembled directly on the bottoms of the slides so as to come into direct contact with their cams.

The throw from fast to slow cam shaft speeds is effected by shifting the trip dogs on the worm wheel, these dogs operating to throw the lever, which in turn operates the Johnson clutch within the gear box. The securing of different cam shaft speeds for cutting is accomplished by pushing the shifter handle in or out, operating on a graduated rod, which throws into mesh different trains of gears within

the gear box. This rod is graduated for eight changes of speed, four being obtained with the gears in one position and four additional by substituting other gears.

The gage stop is capable of simple adjustment and of being easily pushed out of the way for the operator's convenience. A rod, $1\frac{1}{2}$ in. diameter, projects from the lower front of the tool knee between the fourth and first positions and has crosswise slots $\frac{3}{8}$ in. apart, into which drops a lip from the tool knee. This lip holds the shank securely in any selected position; on the end of the rod is a cap for finer adjustment.

The threading device proper is installed in two boxes, one in the third position and one in the fourth position, which boxes are interchangeable. Changing from one threading position to another does not require stripping the machine, but rather the simple loosening of a screw which holds the box in place on its dove-tail slide.

The lubricating oil is drawn by a chain driven, geared pump and forced into a reservoir within the tool head, where it is held under pressure for distribution to the cutting tools.

Fig. 3. Two of the "Stay-Put" Cams

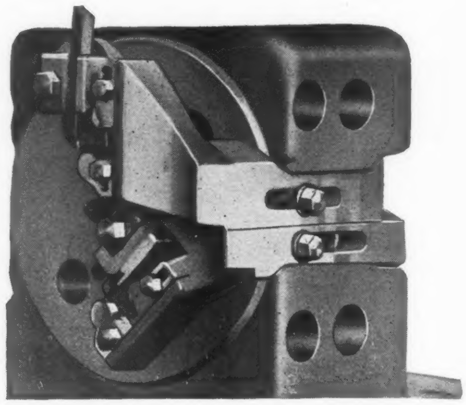


Fig. 4. Turner Slide for Holding Tools

The familiar tool known as the box mill has been superseded by what is known as a Turner slide type of tool, which is illustrated in Fig. 4; a micrometer adjustment is used for raising and lowering the cutting blades.

This machine is the product of the P. W. V. Automatic Machine Corporation, Fitchburg, Mass.

PORTABLE TRANSFORMER FOR LEAD BURNING

THE most modern method of burning terminals in place on storage batteries, removing old connections, cutting off or building up posts, or in fact almost any form of lead work, is to do it by the electric welding process. The General Electric Company, Schenectady, N. Y., has recently developed a lead burning transformer especially designed to meet this need.

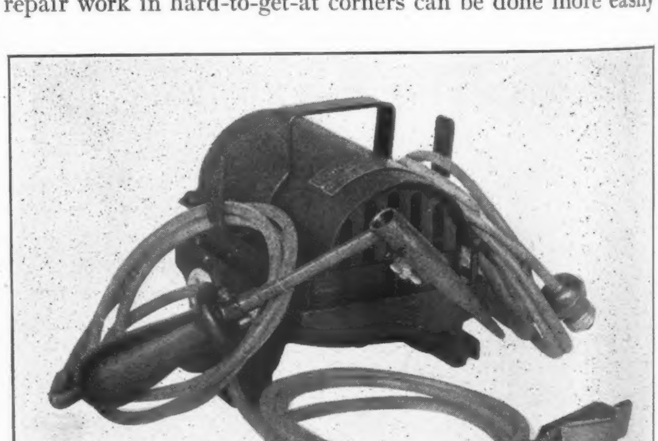
This transformer is designed to be connected to the ordinary 110-volt alternating current lamp socket, a 10-foot cord with a plug being provided for this purpose. This attaching cord is protected by a special rubber covering against the hard wear, dirt or acid with which it may come in contact. Connection to the transformer itself is made by means of a plug and socket connection so that this plug can be used in place of the snap-switch in the lamp socket for turning the current on and off.

Two separate rubber covered terminal leads are used to convey the low voltage heat producing current to the parts of the battery to be welded. The lead having the "Big Brute" clip is for fastening to the battery plate or posts which are to be worked on. The other lead has at its end a carbon holder which is arranged with a heavily insulated handle so that the operator's hand is guarded from the heat. The carbon holder takes any ordinary arc welding carbon, this carbon forming the second terminal.

When the pointed arc welding carbon is brought into contact with the lead the pointed end of the carbon becomes intensely hot, so hot that it melts the lead over a restricted area quicker than a pointed gas flame will do it. The welding or burning operation is carried out by a sort of puddling process, the carbon terminal being manipulated to flow the lead where it is needed.

It will be noted that this is not an arc welding process, and that no arc is drawn during the burning, but the nose of the carbon is kept immersed, perhaps 1/16 in. in the lead.

Among the advantages of the electric lead burner is that repair work in hard-to-get-at corners can be done more easily



Transformer Equipped with Attachment Plug, Big-Brute Clip and Welding Tip

as the heat is always right at the point of the carbon, the device is readily portable weighing approximately 25 lb., joints do not have to be cleaned as the dirt and slag automatically rise to the surface of the molten lead and the surfaces are

joined while cleansed; when properly used, there is no glare to injure the operator's eyes, as he looks down on the cool end of the carbon in such a way that the bright point where the carbon touches the lead is hidden from view; there is no danger from electric shock because of efficient insulation.

On the basis of 10 cents per kilowatt hour, it costs about 8 cents per hour for current when the device is operating steadily. The instant the carbon point is removed from the work, the current consumption practically ceases, as the device then takes only 4½ watts from the line.

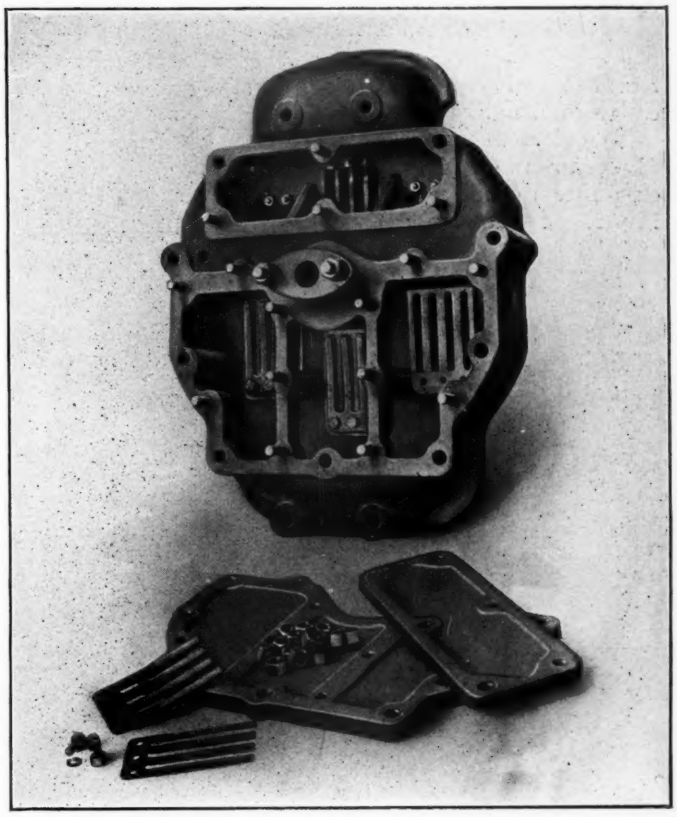
Owners of these transformers have found an increasing field of application. The device is said to be especially valuable in reconstructing and repairing batteries; while in the shop and foundry it has been used where all kinds of odd soldering jobs must be done. The device has also been found applicable in plumbing, roofing, tank building, etc.

AIR COMPRESSOR WITH PLATE TYPE VALVES

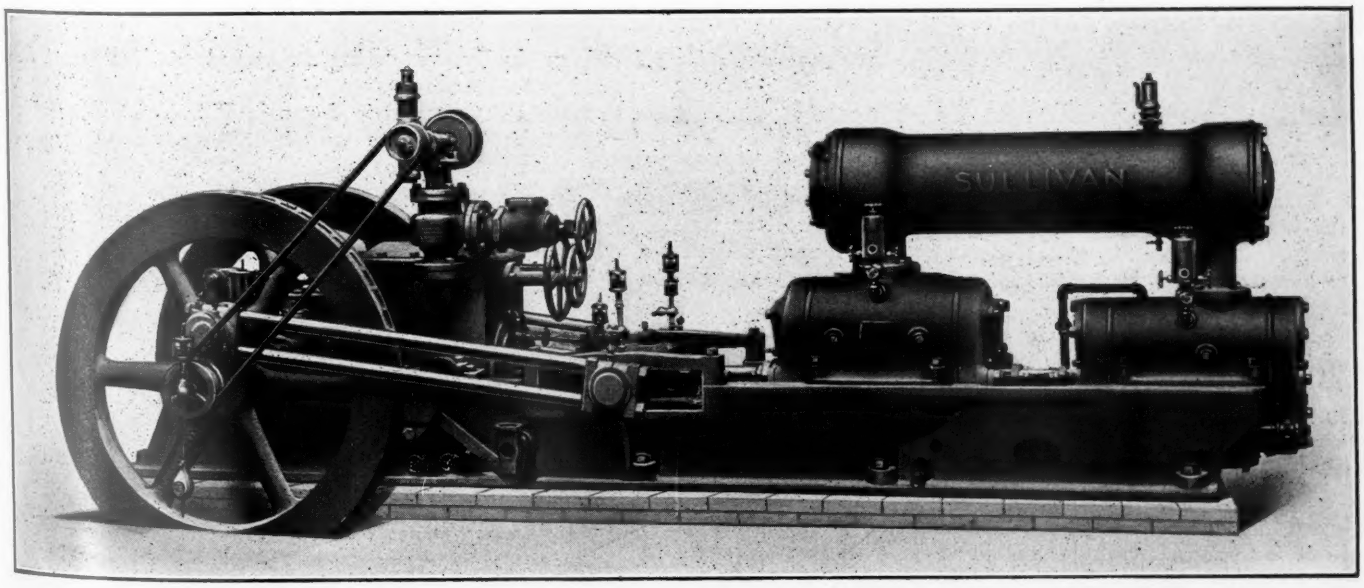
The air compressor shown in the photograph is a redesign of an earlier straight line type of two-stage compressor with a single steam cylinder and two air cylinders, and provides from 400 to 940 cu. in. of free air per minute, compressed to a maximum pressure of 100 lb. per sq. in. One of its principal improvements consists of a speed and pressure governor admitting of three adjustments, namely, maximum and minimum speed and air pressure, each adjustment being independent of the others. The speed controlling element is entirely enclosed in a casing to protect it from dirt.

End rolling finger valves constitute another important new application to the air cylinder heads and are illustrated in the view which shows a cylinder head with the cover removed. These valves consist of thin flat steel sheets cut to form four finger-like blades; these are bolted at one end to the cylinder heads so that the fingers seat over long narrow ports which are opened or closed according to whether the fingers rest flat against the seat or are bent backward away from it. To protect the valves and prevent excessive lifting from the seats they are covered by steel guards having the same general shape as the valves, but made of a thicker material and given a definite curve away from the valve seat. In opening the fingers impinge against these guards with a rolling motion, hence the name "rolling finger valve." It is stated that the end rolling effect eliminates the hammering which commonly occurs in the operation of air valves and provides a rapidity of action, wide port opening with minimum wire drawing, and a reduction in the number of moving parts.

These pumps, known as the Sullivan WB-3 air compressors, are manufactured by the Sullivan Machinery Company, Chicago, in two sizes.



Cylinder Head with Valve Covers and Some of the Valves Removed



Class WB-3 Air Compressor, Straight Line Type with Simple Steam and Two-Stage Air Cylinders

A MACHINE FOR SHARPENING OLD FILES

THE American file sharpening machine, manufactured by the Abrasive Machine Company, Irvington, N. J., is designed for the resharpening of old files of all kinds. The resharpening of a dull file is accomplished through the grinding action of a patented abrasive combination known as Carboflynt, mixed with water, propelled at high velocity by a jet of steam through a nozzle.

A cross section of the nozzle (Fig. 1) shows a flat file in the proper resharpening position, resting on the bevelled edge of a block of metal called the "test iron" because of the fact that a properly resharpened file will gently adhere to its surface. The correct angle of the file to the jet of Carboflynt shown projected from the nozzle is about 30 deg. and the bevel on the test iron serves as a guide to the operator in handling the file.

An enlarged longitudinal section of the teeth of a new file is shown at *A* in Fig. 2; the result of the grinding action on the teeth of an old file is shown by the dotted lines in *B*, Fig. 2. It will be seen that the Carboflynt jet grinds away

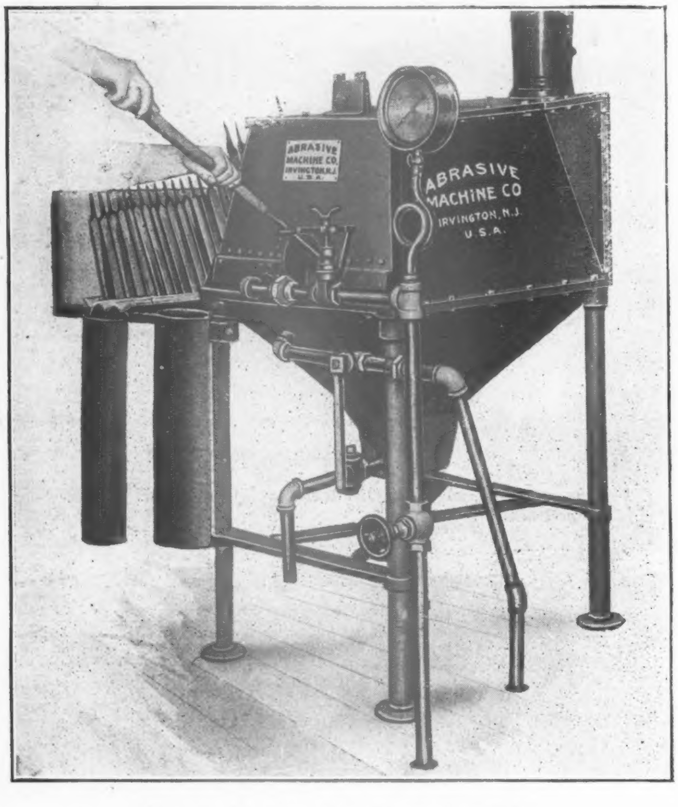


Fig. 3—Machine for Sharpening Files

the back of the teeth, leaving the cutting edge clean and sharp. The operation requires about half a minute and the resharpening can be performed as often as there are any teeth left to work on.

It is estimated that by the use of this machine, old files can be put back into use, practically as good as new, at a cost not to exceed 10 per cent of their original value. It is further stated that ten pounds of Carboflynt at 10 cents per pound will resharpen $300 worth of files, owing to the fact that the Carboflynt is used over and over again.

The complete machine is shown in Fig. 3 and consists of a sheet metal box mounted on a stand with an opening in front for admission of the nozzle and the file. The partly open window on the left is for the purpose of replenishing the supply of Carboflynt and water when necessary; an overflow pipe controls the level of the water in the hopper.

The vertically mounted cylindrical tank at the right hand side is a water container, used for dipping files to clean them when drawn from the chamber.

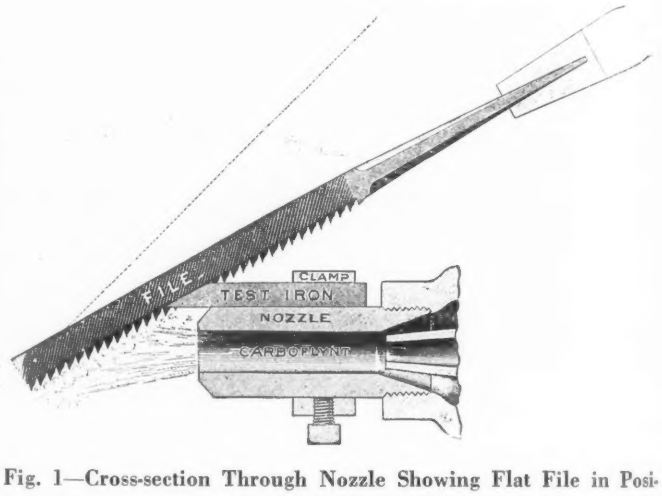


Fig. 1—Cross-section Through Nozzle Showing Flat File in Position for Resharpening

The method used in the treatment of files in the American file sharpening machine does not subject them to the danger of "losing their temper" in the slightest degree, and this

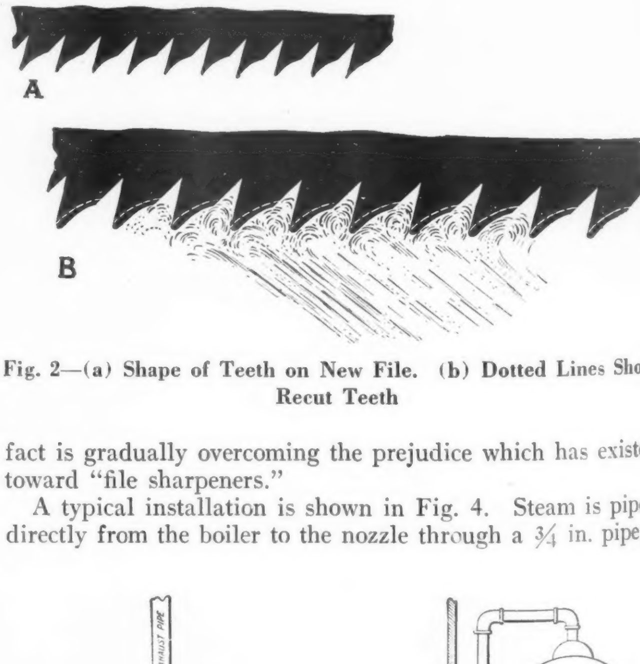


Fig. 2—(a) Shape of Teeth on New File. (b) Dotted Lines Show Recut Teeth

fact is gradually overcoming the prejudice which has existed toward "file sharpeners."

A typical installation is shown in Fig. 4. Steam is piped directly from the boiler to the nozzle through a 3/4 in. pipe;

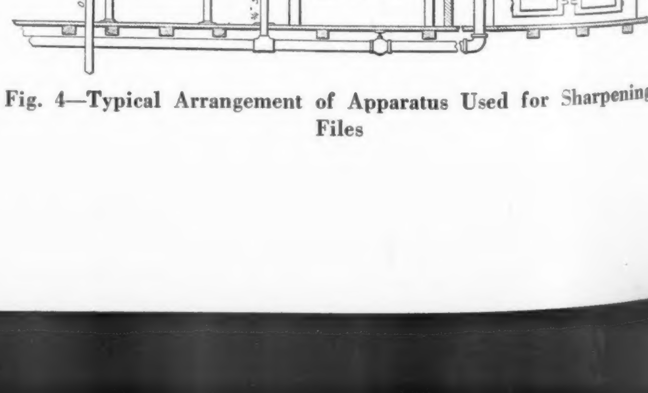


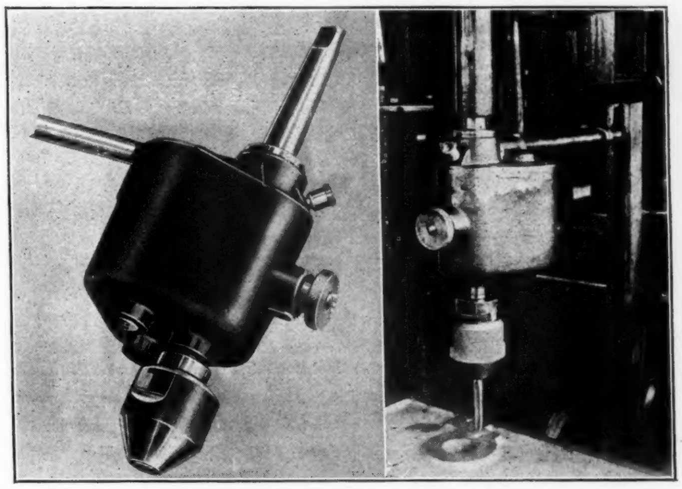
Fig. 4—Typical Arrangement of Apparatus Used for Sharpening Files

the pressure recommended for the best results is from 85 to 150 lb. of steam. Where steam is unavailable, compressed air has been used with success. Among recent installations that have been made are machines for Pennsylvania Railroad at Reading, Pa., and the Mobile & Ohio Railroad at Murphysboro, Ill.

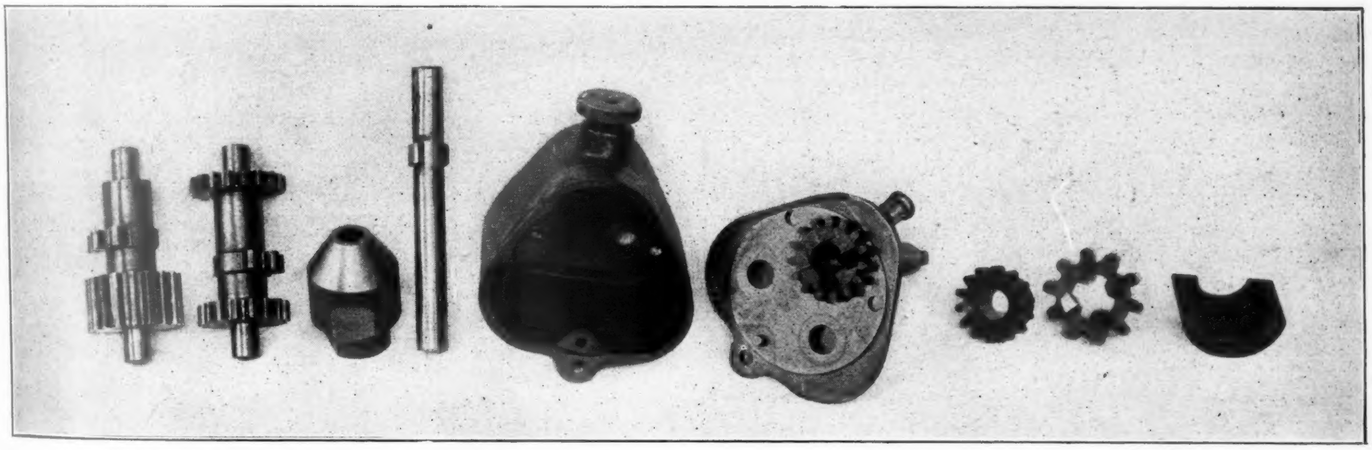
BACKING OFF THE TAP MECHANICALLY

THE mechanical tapping attachment for a drill press shown in the photographs is so constructed that in operation it imitates the motion of the human hand, advancing the tap into the work and then, reversing itself automatically, it backs out the tap sufficiently to clear itself, when it again resumes its forward direction. This is particularly necessary in tapping steel or tough material. The forward movement being greater than the backward movement advances the tap. The return movement in backing the tap out is continuous and at an increased speed. This automatic oscillating operation is considerably faster than hand tapping. By the use of this apparatus the entire tapping job may be done with the finishing tap only, thus eliminating the preliminary work of starting taps; the time saving economy of this, in addition to the speed at which the apparatus can be run, is manifest.

The device is foolproof and strongly made; no springs are used in its design and it can be instantly changed from the oscillating to a continuous drive for use in soft metals where the automatic "backing off" is not required, by the operation of the knob on the front of the machine. Turning the knob disengages a clutch, which throws a gear on the countershaft out of mesh with the tapping spindle.



(Left) Automatic Tapping Attachment Which Imitates Hand Tapping. (Right) Application of Tapping Attachment



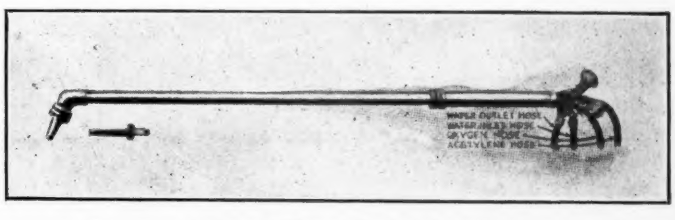
Parts of the Automatic Oscillating Tapping Attachment

These machines, carrying a No. 2 Morse taper shank, are furnished for all sizes of taps up to 3/8 in. by the Wahlstrom Tool Company of Brooklyn, N. Y.

WATER-COOLED WELDING TORCH FOR HEAVY WORK

MUCH time and gas are often wasted because of the overheating of the tip of the oxy-acetylene welding torch when the work must be done in hot corners, in holes, or in the handling of heavy and difficult work. A big saving could also be effected on some jobs if the preheating blast could be kept on the weld while the metal is being fused, or if two or more torches could be used continuously to secure and retain the proper heat. The Admiral Welding Machine Company, Kansas City, Mo., has developed a water cooled torch to meet these difficulties.

The circulation of the water keeps all parts of the torch cool and because of this the torch will work uniformly on a weld of any thickness. It is said that if the torch is suspended from the ceiling by a wire or cable and the welder



Admiral Water Cooled Torch

is protected from the heat, the torch may be kept on a weld indefinitely, and if necessary the welders can take turns in operating it. The torch may be connected to the city water pressure or even to a barrel or tank, as the amount of water required is not very great.

The torch is 34 in. in length, weighs 3 lb., and is furnished with two interchangeable tips. The connections are ground joints and the torch may be quickly taken apart in order to remove any scale or obstruction in the water line. It is finished in brass with knurled fittings.

NEW LUBRICANTS AND CUTTING OILS

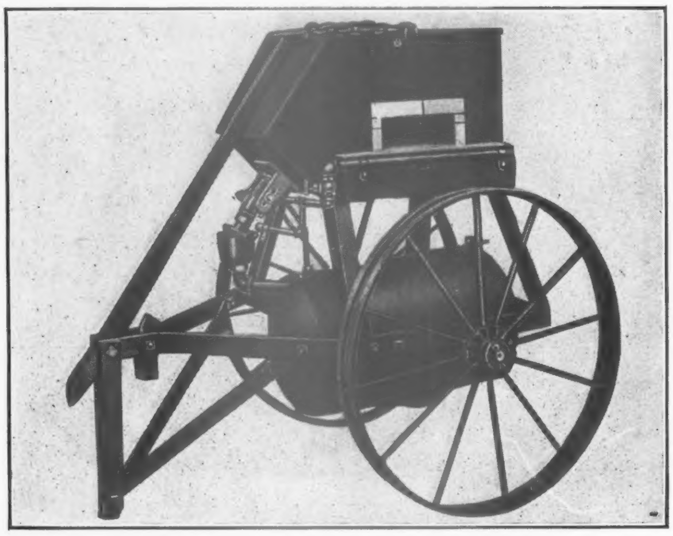
IN addition to three grades of cutting oils recommended as substitutes for lard oil on account of their greater cooling qualities, a lubricant especially developed for use in portable pneumatic tools and said to have unusual consistency and lasting qualities, has been recently introduced by the Fiske Brothers Refining Company, New York.

Their No. 1040 cutting oil is light in body and is intended for light cutting operations, No. 1770 is prescribed for medium work and No. 2020 is furnished for extremely heavy work.

A product known as Ferrol Economizer, which is said to be impervious to fresh or salty water or water containing acids, and is not affected by heat or cold, is also manufactured by this company for lubricating gears, chains and ropes, or for use wherever a question of extreme temperature or high bearing pressure with low speed arises.

OIL FUEL RIVET FORGE FOR THE REPAIR TRACK

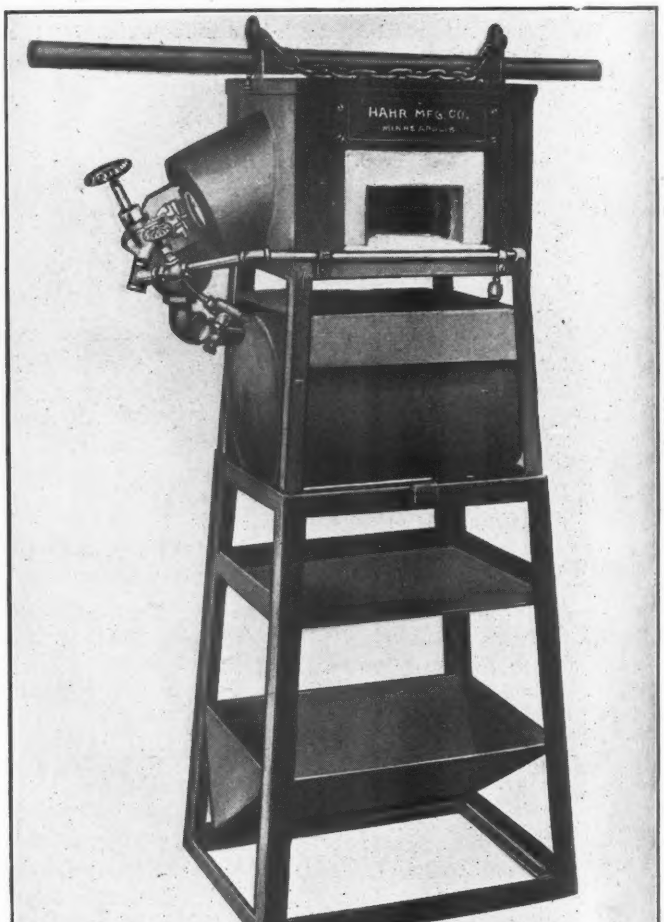
HIGH wheels clear the tracks and the comparatively low center of gravity due to the fuel tank's location near the center of the axle of the wheels in the rivet forge illustrated herewith, decreases the difficulty of getting it from one section of the "rip track" to another in car repair work. The handle used in pulling it folds back against the body of the forge without interference. The operation of this forge, which will heat four hundred ¾-in. by 3-in. rivets per hour, involves the use of a special burner constructed on the vacuum principle, which makes it possible to burn any grade



Oil Fuel Rivet Forge for Car Repair Work

of fuel oil or kerosene, without pressure on the 18-gallon fuel tank. This is a "safety first" consideration of no mean value.

The forge is made by the Mahr Manufacturing Company, Minneapolis, Minn., and the burner is of the standard type made by that company. A hollow chamber through which passes the air used in atomizing the oil, extends across the front of the furnace above the opening. At the entrance to this chamber a portion of the air is led down to a point below the furnace, opening into a perforated pipe. From this chamber the air passes to the atomizing valve. An oil chamber is formed in the lower end of the lead, the oil passing up through this chamber, where it is pre-heated. From there it passes to the atomizing valve, being at such a temperature that when the hot air strikes it it becomes immediately gasified, passing into the combustion chamber in that condition. A by-pass from the air pipe passes up above



Rivet Forge Mounted on Convenient Stand

the combustion chamber and feeds air into the furnace, in this way insuring perfect combustion of the oil. An interesting feature in the performance of this furnace is the lack of scale formed on the work; this is accomplished by having

a neutral flame, no more air being admitted than is necessary thoroughly to consume the oil. The flow of the air through the by-pass is controlled by a valve, as is the air and oil mixture. The atomizing valve also is of a distinctive design. It is constructed on the piston valve principle and permits passing the impurities in the oil through to the combustion chamber without danger of clogging the valve.

A small portable forge is also shown, using the same principles of operation as the outfit described above. It is conveniently mounted on a strong, wrought iron stand provided with two trays; the bottom one may be used as a cold rivet bin, the upper one for tools.

MULTIPLE PUNCH FOR CAR UNDERFRAMES

BY GEORGE P. THOMAS
President, Thomas Spacing Machine Company, Pittsburgh, Pa.

THE NECESSITY of reducing manufacturing cost, with labor cost tending to stay fixed, makes standardization of design a most important consideration in plants engaged in steel construction, such as steel car shops. Only on the basis of standardized design is it possible to take advantage of the possibilities offered by special tools which will increase output and cheapen unit costs through quantity production.

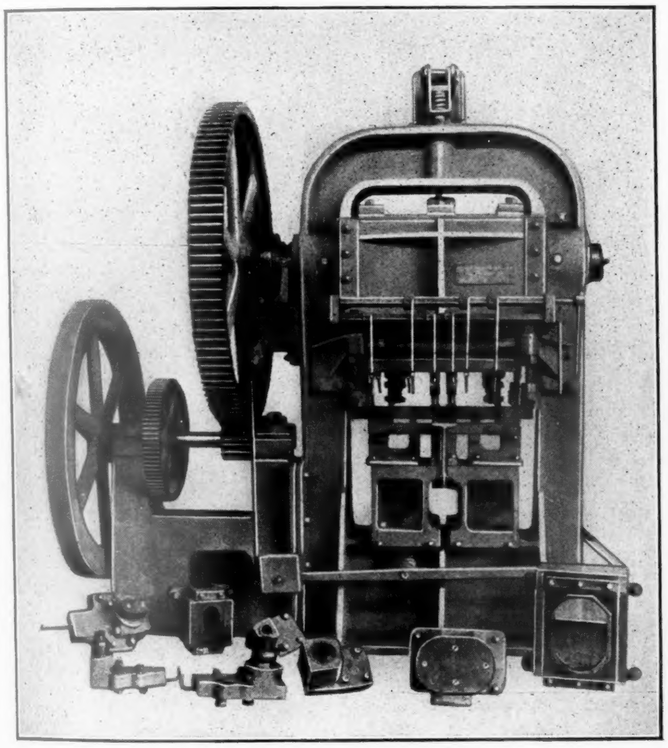


Fig. 1—Car Underframe Type Multiple Punch with Interchangeable Special Tools

The demand for a punching machine with a wide range of application, such as is found in the steel car shops, was responsible for the design, or perhaps it may better be said, the development, of the machine here described. The punch with several of the interchangeable punching and blanking-out tools and dies is shown in Fig. 1. This machine was built for one of the large tank car companies. Its utility and capacity are greatly increased when it is operated in conjunction with a spacing table, as described in subsequent paragraphs.

Steel car underframe work requires punching, shearing and sometimes coping and blanking-out of plates or structural sections. In some cases the structural sections are made by flanging flat plates, which are punched most readily before being flanged. Tool set-ups suitable for these operations are shown in Figs. 2 and 3. With other tools and spacing blocks to suit, angles up to 6 in. x 6 in. x 5/8 in. can be punched singly or in pairs, the latter method having the advantage that, with the clamping device illustrated in Fig. 1, the angles are held back to back, and the tendency to curling is overcome and the holes are uniformly spaced with reference to the heel of the angle. Likewise, I-beams up to 6-in. flange and 15-in. web and channels of corresponding dimensions can be punched on either the flanges or web, the channels for flange punching being handled in pairs as though they were an I-beam, by means of the automatic, cam-operated clamping device illustrated in Fig. 1. In punching channels, the web is always punched first. For punching the webs of beams and channels, guide rollers

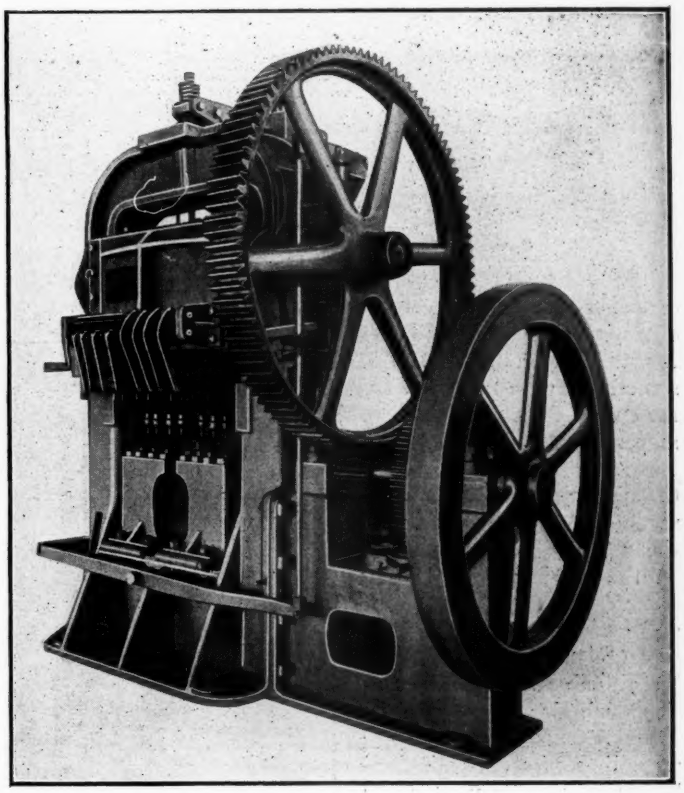


Fig. 2—Punch Equipped with Tools for Multiple Punching of Plates

are mounted on the punch blocks in the same way that the die holders are held in place, that is, by means of T-head bolts. Z-bars are also handled in pairs with a special set-up, for either web or flange punching. For this work, high and low die holders, and long and short punch spindles are required. As the clearance between housings is approximately 39 inches, plates or sills up to 36 inches in width can be punched.

The design of this tool is such that it can be fitted up very readily with coping tools, or it can be converted into

a gate shear, guillotine type shear, angle and channel shear, or bar shear.

The adaptability of this multiple punch for use in connection with a spacing table is shown in Fig. 4, in which the spacing carriage (of the hand-operated type) is shown in the foreground in place on the roll table. The trailer carriage, for guiding the trailing end of the plate or other member while going through the punch is shown somewhat indistinctly on the far end of the roll table. The movement of the spacing carriage in advancing the plate through the punch can be made entirely automatic by the use of a motor mounted on the carriage and driving through a clutch arrangement and gear train to the pinions that are to be seen in the illustration adjacent to the carriage wheels. However, as the rollers of the roll table are all equipped with ball bearings, the heaviest plate can be moved by hand with remarkable ease.

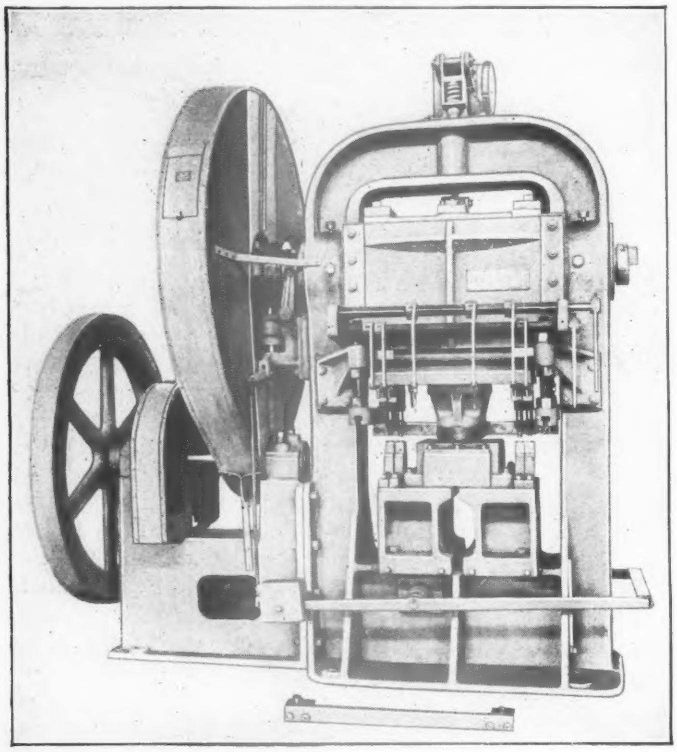


Fig. 3—Set-Up of Tools for Blanking Out Web of Channel and Punching at Each Side in Pairs

Whether motor or hand driven, the spacing between holes or rows of holes, as the case may be, lengthwise of the plate, is automatically controlled by means of a full-sized templet which is fastened to the side of the roll table by means of clamps. This templet is simply a wooden strip, which can be prepared in the pattern shop, having steel pins driven in at intervals corresponding to the pitch between holes, measured lengthwise of the plate. The drawing for the punching layout is used in making this templet which is thereafter identified by being marked with this drawing number. These steel pins on the templet simply serve to actuate the tripping mechanism on the spacing carriage, which in turn releases a set of pawls that drop by gravity into the spacing rack mounted on the framework of the table. The operation of these pawls is electrically interlocked with the operation of the ram of the punch, so that when the pawls are down in the spacing rack, locking the carriage where it is stopped, the punch can then operate, and as soon as the punching tools strip the plate a cam-operated contact on the main cam shaft of the punch closes the circuit to the solenoid shown in Fig. 4 mounted on the carriage, which operates to lift the pawls out of the spacing rack and thus allows the carriage to advance with the plate to which it is clamped until the next spacing pin on the templet again causes the carriage to stop while the punch makes another stroke.

The standard punching tools can be set to a minimum of 2-inch centers, and may be controlled singly or in groups. Thus, the number of holes punched at a time across the plate with each stroke of the punch is under the control of the operator by means of the hand levers which operate the gags in the respective punching tool holders. This is shown most plainly in Fig. 2 in which the gags for the eight punching tools are seen to be linked up to the arms mounted on the two horizontal operating bars in two groups of four each. In Fig. 3, a different grouping of gag controls is shown. The two middle arms on the upper bar are idle; the third arm operates the gag for the inner tool on the right-hand side. The other three tools are controlled by the lower gag-operating bar. With hand-operated gag control, the operator has to be on the alert to work the proper combinations of gags to give the required punching layout for each successive position of the plate as it advances through the punch.

A method of automatically controlling the operation of

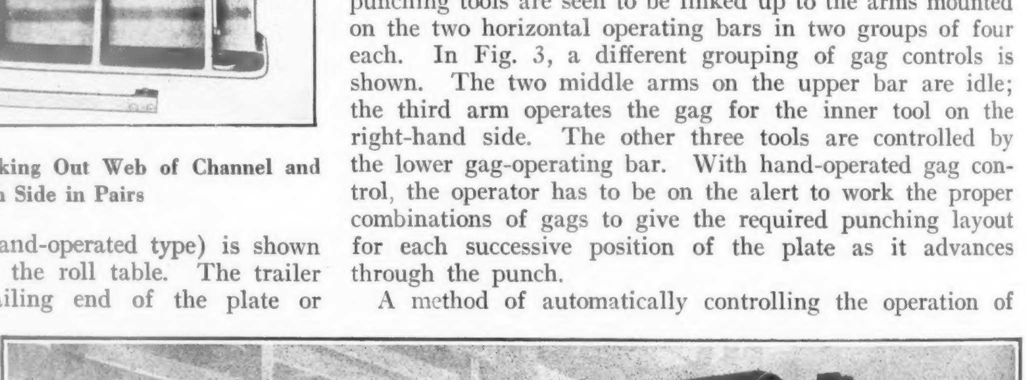


Fig. 4—30-Inch Automatic Spacing Table, and Punch Equipped with Gag Control Mechanism

the gags is shown in Fig. 4. The drum is driven through a gear train from the main cam shaft of the multiple punch. Pins properly located on the drum operate through the vertical connecting rods to throw the gags in and out of the tool holders. With this automatic gag control in operation on a multiple punch also equipped with an automatic spacing table, it is possible to put through the most complicated punching layout without the possibility of errors due to mistakes of an operator, and, moreover, with this full-automatic equipment, it is possible to tune up the equipment to the point of maximum productive capacity without danger of losses due to incorrect operation of the equipment. It will be evident, however, to even the casual observer that the use of full-automatic equipment such as this presupposes quantity production of standardized punching layouts, although it is a comparatively simple matter to change over the complete set-up of the punches and dies, gag control, and spacing templet for an entirely new punching layout, only a short time being involved in making the change.

The two side housings of this multiple punch and the top yoke are cast as a unit, the bearings for the main cam shaft being carried in the side frames without splitting the bearing housings. These babbitted bearings are carried in solid bronze shells, one of which has an outside diameter such as to allow the cam shaft, with the cam forged solid thereon, to be threaded through the housing in assembling the machine. After the cam shaft is in position the bronze bearing shell is slipped over the shaft and into place, where it is securely locked.

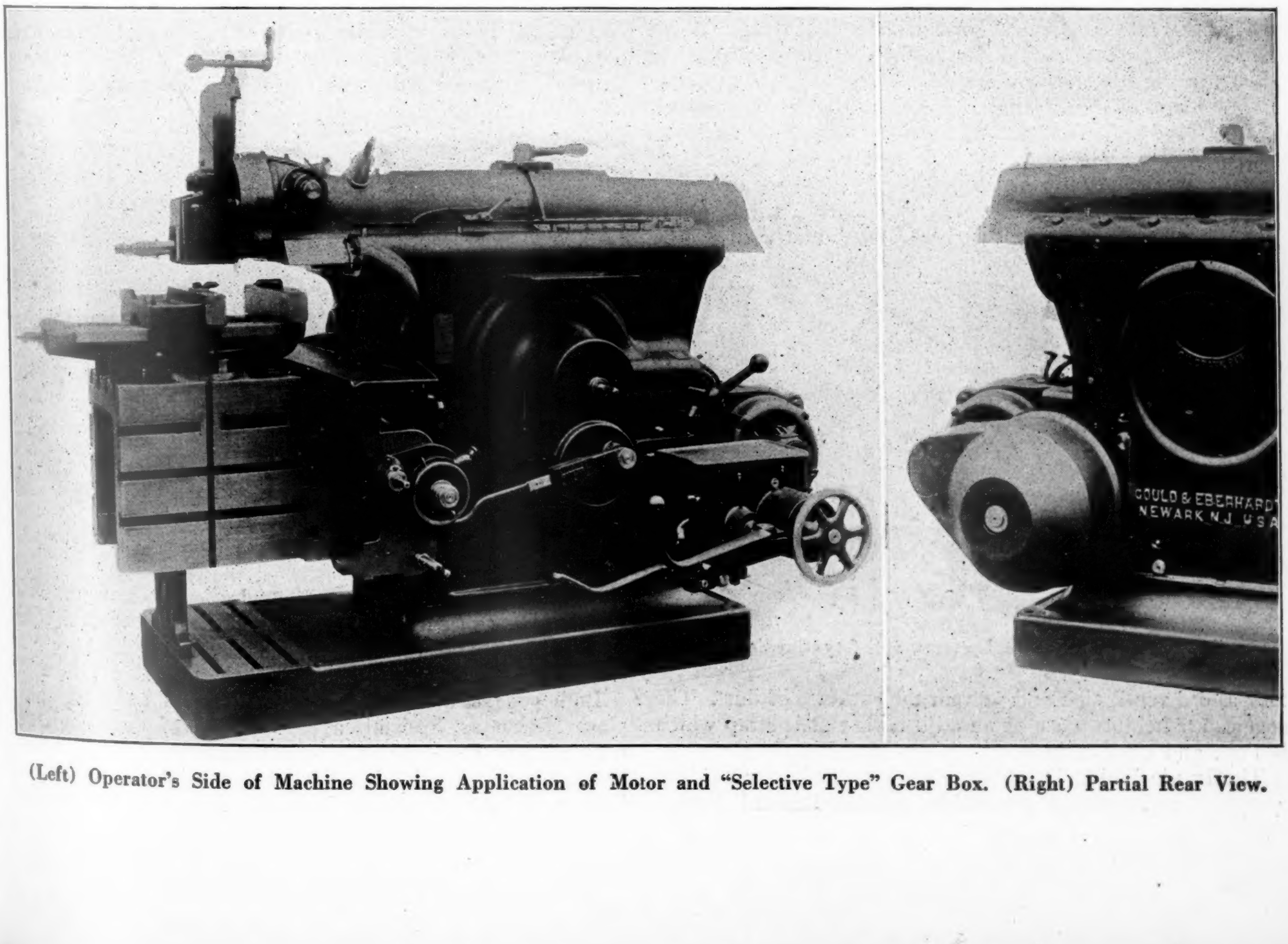
The advantages of this construction are, first, the extreme rigidity of the frame in comparison with the ordinary open throat or "C"-type punch used for the same work; second, lighter weight, which justifies the use of cast steel instead of cast iron for the frame, thus introducing a much higher factor of safety; third, much smaller floor space required for the punch; fourth, greater strength with a one-piece frame casting than with frame made in sections and bolted together; fifth, the tension strains are carried in a straight line from the shaft to the base, thereby insuring maximum strength and rigidity, which in turn results in longer service from the punching tools and dies.

The capacity of the punch here illustrated, which is designated as a No. 14 machine, is 450,000-lb. ram pressure, or in other words a capacity for punching a 2-inch hole in 1¼-in. plate, or its equivalent, and for shearing flats up to 8 in. x 1¼ in., and rounds up to 2¾ in. The ram has a travel of 2 in., and at normal speed makes 26 strokes per minute. This machine requires a 10-H. P. driving motor.

CONSTANT SPEED MOTOR DRIVE FOR SHAPER

GOULD & EBERHARDT, Newark, N. J., have designed what is known as a selective type gear box, with steel case-hardened gears, which may be used with a constant speed motor drive or a single pulley belt drive, giving the same changes of speed as are ordinarily obtained with the cone pulley drive. It is unnecessary to stop the machine in changing speed except when changing from single gear to back gear, or vice-versa.

A 10 h. p., 1,200 r. p. m., constant speed motor is used on the 28-in. Invincible shaper shown in the photographs. This machine, by the way, will be exhibited at the mechanical conventions at Atlantic City. Eight changes of speed may be obtained for every change in stroke. Some idea of the proportions of the gear box and the motor and of the relative location of the control levers and wheel on the operator's side of the machine may be obtained from the photographs.



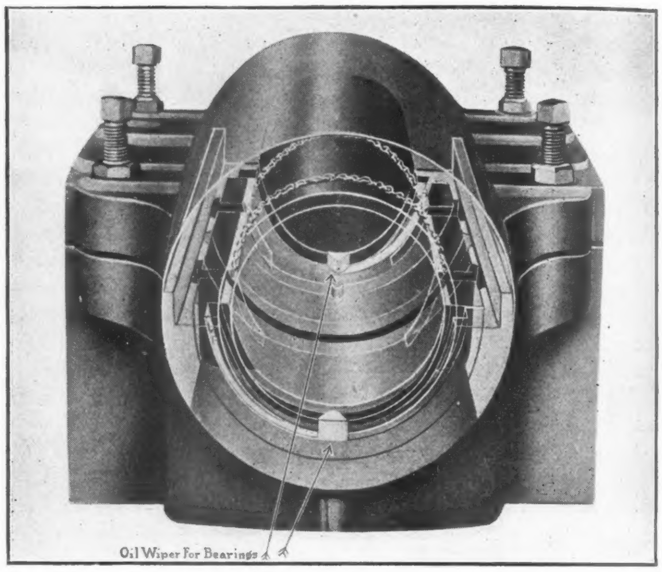
(Left) Operator's Side of Machine Showing Application of Motor and "Selective Type" Gear Box. (Right) Partial Rear View.

The shaper has a range of cutting strokes of from 9 to 115. The maximum stroke is 28¾ in. and it planes for a width of 29 in. The maximum distance from the table to the ram is 17½ in., and the minimum distance is 4¼ in. The head has a vertical movement of 8 in., while the table has a similar movement of 13½ in.

AN OIL CONSERVER FOR BEARINGS

An improvement in the application of oil wipers for bearings is shown in the illustration. It consists of a tempered steel spring with a triangular shaped piece of babbit metal mounted on the end. The babbitt is shaped to the shaft and wipes the shaft clean, returning the oil to the reservoir of the bearing. The spring is fastened to a convenient point in the groove at the end of the bearing or to the housing. A wiper is placed at each end, and it is stated that it will hug the shaft under all conditions even if the bearing wears or the shaft thins so as to normally pull away from the wiper. Reversing the direction of the shaft will not decrease the effectiveness of the wipers, which are furnished for all plain roller or ball self-oiling bearings.

These new oil wipers are manufactured by the Industrial Products Company, Detroit, Mich. The makers state that bearings equipped with these wipers have been in satisfactory service for over two and a half years; tests and records show that the saving in oil required for replacement has been not less than 85 per cent on line shafts 6 inches in diameter and upwards. On tests run for the last four months on 10 bearings, each transmitting 250 h. p., there has been required one gallon of oil for replacement on all 10 bearings.

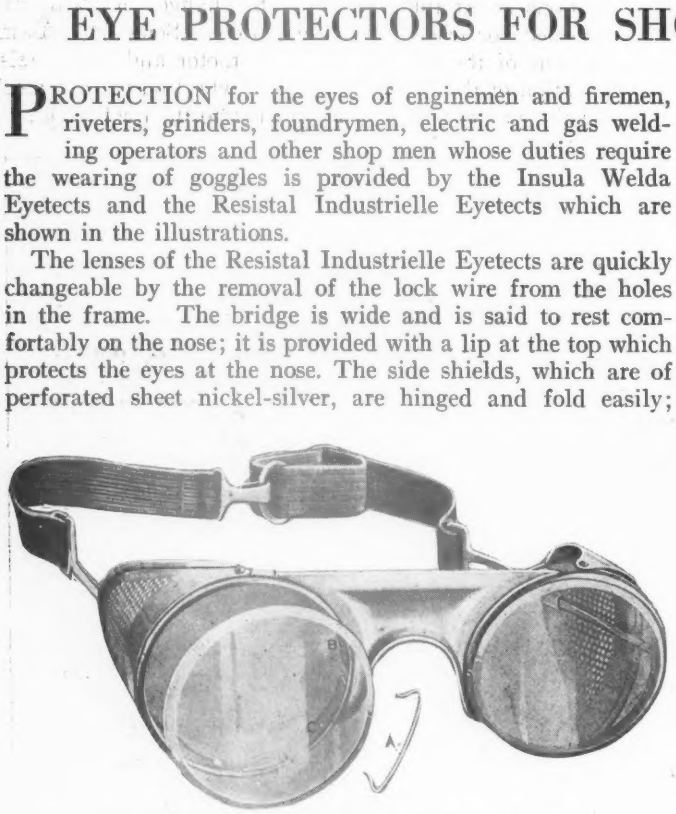


Oil Wiper for Bearings

EYE PROTECTORS FOR SHOP AND LOCOMOTIVE MEN

Protection for the eyes of enginemen and firemen, riveters, grinders, foundrymen, electric and gas welding operators and other shop men whose duties require the wearing of goggles is provided by the Insula Welda Eyetects and the Resistal Industrielle Eyetects which are shown in the illustrations.

The lenses of the Resistal Industrielle Eyetects are quickly changeable by the removal of the lock wire from the holes in the frame. The bridge is wide and is said to rest comfortably on the nose; it is provided with a lip at the top which protects the eyes at the nose. The side shields, which are of perforated sheet nickel-silver, are hinged and fold easily; they afford ventilation and prevent the entrance of dust. The goggles are held in place by an adjustable elastic strap which is light and comfortable.



Resistal Industrielle Eyetects, a Safety Goggle

The Insula Welda Eyetects are made specially for welding operators and contain removable colored Resistal lenses, for which it is claimed no harmful glare can penetrate, yet provides a perfect vision for the operator. The nose bridge is an adjustable strap. The shield has five ventilating holes behind the lens cap to admit air. There are also four compression slots on the circumference of the shield which make it possible for the lens cap to be slipped over the shield and be held in place by friction. The elastic also serves to hold the friction cap snugly in place regardless of the thickness of the lens. This construction makes it possible quickly to remove and replace the lenses while the goggles are in use.

A Goggle for Welders, Known as the Insula Welda Eyetects

Both goggles are provided with lenses of non-shatterable glass known as Resistal, a combination of double glasses with a layer of transparent celluloid between them, which has satisfied an official government test conducted by the Bureau of Standards as to its safety features. The follow-

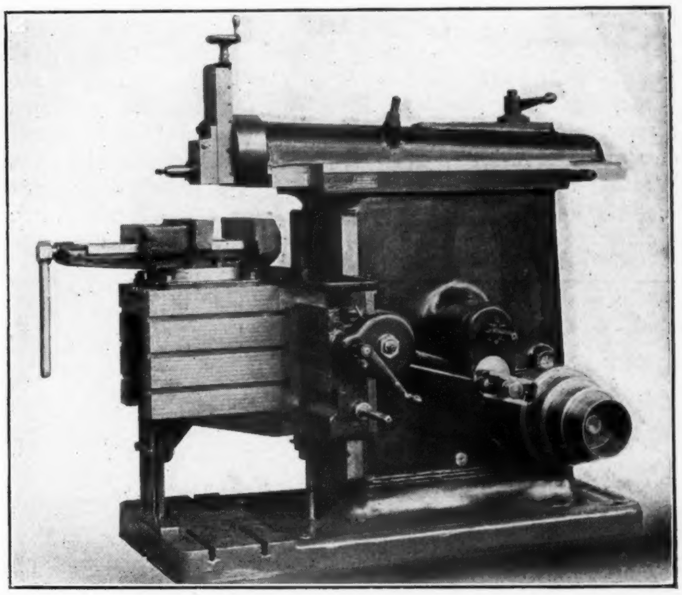
ing sentence is taken from one of the Bureau's reports: "In view of the tenacity with which celluloid holds glass and prevents it from shattering, the slightly lower light transmission of such a combination is probably compensated by the superior protection offered to the eyes in case of accident to the goggles."

These goggles are manufactured by Strauss & Buegeleisen, New York City.

20-INCH BACK GEARED CRANK SHAPER

THE Springfield Machine Tool Company, Springfield, Ohio, has added to its line of shapers a 20-in model, which is similar in all respects, except size, to its 25-in. back geared crank shaper. The column has well rounded corners and is internally ribbed; the ram is exceptionally long with ample bearing surface. The tool head has a long travel and has a down feed screw with a micrometer collar attachment. The tool block feeds 9½ in. in any direction, and the size of tools used is ¾ in. by 1½ in. The 15¼-in. by 20-in. table has a transverse movement of 32 in. and a clearance of 17 in. from its top to the ram. The cross-rail is long and deep and is elevated by means of a telescopic screw provided with a ball bearing thrust. One gib is provided with an angular rear face, so that the cross-rail is always kept square with the column. The cross-rail is provided with automatic cross feed in either direction and the cross feed screw has a micrometer collar.

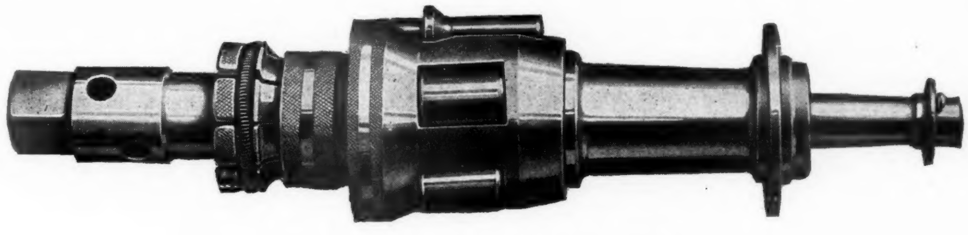
The cross slide has an extra large bearing surface on the cross-rail. The vise is clamped to the table and revolves upon a graduated index plate which is keyed to the table. By means of an index pin it can be readily locked at right angles or parallel with the ram. The vise jaws are lined with steel and provided with a tension screw. The crank gears are made with large pitches and wide faces. The stroke arm is connected to the ram by means of a link, providing ample space to allow a 4-in. shaft to pass entirely through the column for keyseating or any other similar operation. The stroke is varied from a convenient point and adjustment is possible while the machine is in motion. Eight speeds are provided and the number of strokes per minute varies from 7 to 129. The machine occupies a floor space of 56 in. by 136 in. and weighs 4,850 lb.



Springfield 20-in. Crank Shaper

DOUBLE UTILITY TOOL FOR BOILER TUBES

THE self-feeding flue expander illustrated is designed to "finish the job" by flaring the end of the flue before the expander is withdrawn; it saves the time required for flaring with an additional tool in a different operation. When the expander has been inserted into the flue to the point of the flaring part of the flaring roller, the mandrel is turned to the right and the flue is rolled tight in the sheet. To obtain the flare the mandrel stop is placed against the cage, which prevents the mandrel from entering the expander further, and then by continuing to turn the mandrel to the right the expander is forced further into the flue and the flare is produced. To remove the expander the mandrel is turned to the left. It is stated that a perfect job of rolling flues tight in the sheet can be performed, and that any angle of flare up to 45 deg. can be made.

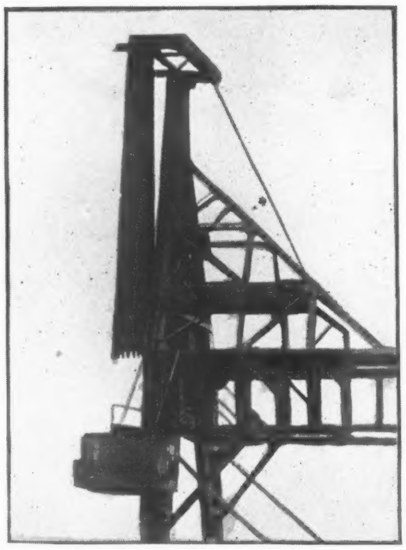


Tool for Expanding and Flaring Tubes

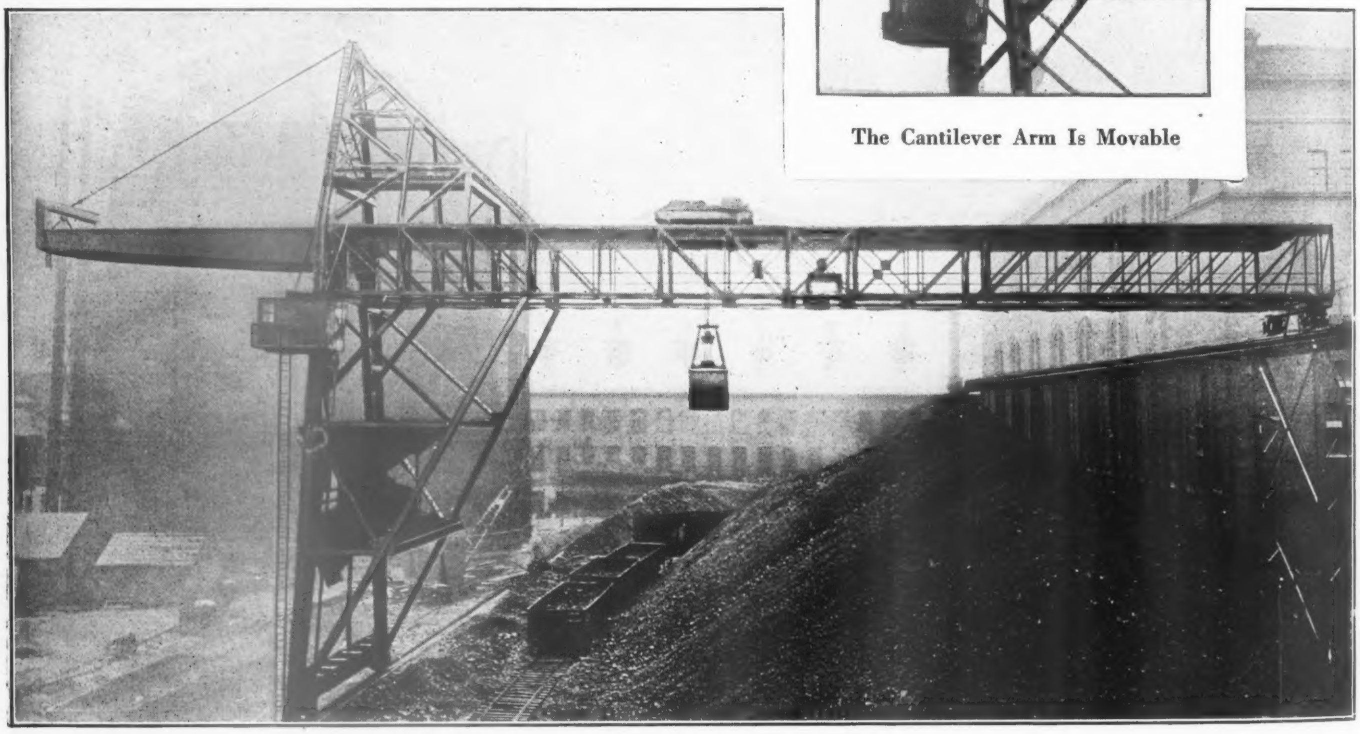
This tool is known as the locomotive superheater expander and is made in several sizes, for 4½-in., 4¾-in., 5-in. and 5½-in. flues, by the J. Faessler Manufacturing Company, Moberly, Mo., who also manufacture a similar tool for locomotive arch tubes and water tube boiler flues. The latter, in sizes ranging from 2½ in. to 4½ in., are provided with collars which are adjustable up to a maximum distance of 10 in. or more between the base of the collar and the center of the rollers. In operation, the adjustable collar on the cage shank is set back from the outside sheet to the distance the tube projects from the inside sheet and then the operator proceeds exactly as with the other tools, already described. These tools do not pinch or thin the tube at the bottom of the flare and the outside edge of the sheet; these parts are left the same thickness as the body of the tube.

AN EFFICIENT COAL HANDLING APPARATUS

TWO HUNDRED AND FIFTY tons of coal per hour is shown in the illustration. It is adapted for the han- the rated capacity of the gantry type bucket crane dling of ashes, cement, clinker, crushed rock, stone, slag, sand, gravel and other loose materials. The span between the rails in the installation shown is 138 ft. 9 in. The effective cantilever is 43 ft. 9 in.; the over-all height of the gantry leg is 97 ft. 3 in., and the lifting speed of the bucket is 320 ft. per minute. Coal is crushed before it is delivered to the power house by a 250-ton capacity crusher attached to the gantry leg. The cantilever leg is movable and can be drawn up out of the way at places where there is not sufficient clearance. The installation shown was manufactured by the Whiting Foundry Equipment Company, Harvey, Ill., manufacturers of a line of industrial cranes and hoisting apparatus, including special types adapted for railway cinder pits.



The Cantilever Arm Is Movable

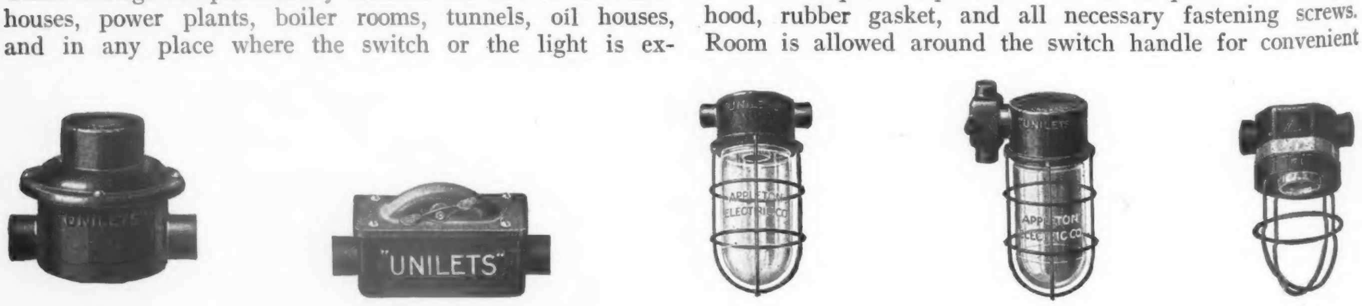


Whiting Bucket Crane, Gantry Type; Capacity 250 Tons Per Hour

VAPOR AND MOISTURE PROOF ELECTRICAL FITTINGS

THE Appleton Electric Company, Chicago, Ill., has added several weather-proof, and vapor and moisture proof fittings, to its line of "Unilet" conduit fittings. These fittings are particularly suitable for service in roundhouses, power plants, boiler rooms, tunnels, oil houses, and in any place where the switch or the light is exposed to weather, to locomotive gases, or to moisture.

The weather-proof snap switch fitting is No. 1 in the illustration. The bridge in the fitting permits of mounting any 5 or 10 ampere snap switch. It is complete with flanged hood, rubber gasket, and all necessary fastening screws. Room is allowed around the switch handle for convenient



1 2 3 4 5

Moisture Proof Conduit Switch Fittings and Outlets

use. When a lock switch is desired, the switch handle may be removed and replaced with lock attachment. Extension stems are furnished for use with Perkins' switches, but stems for other makes can be furnished if the make is specified.

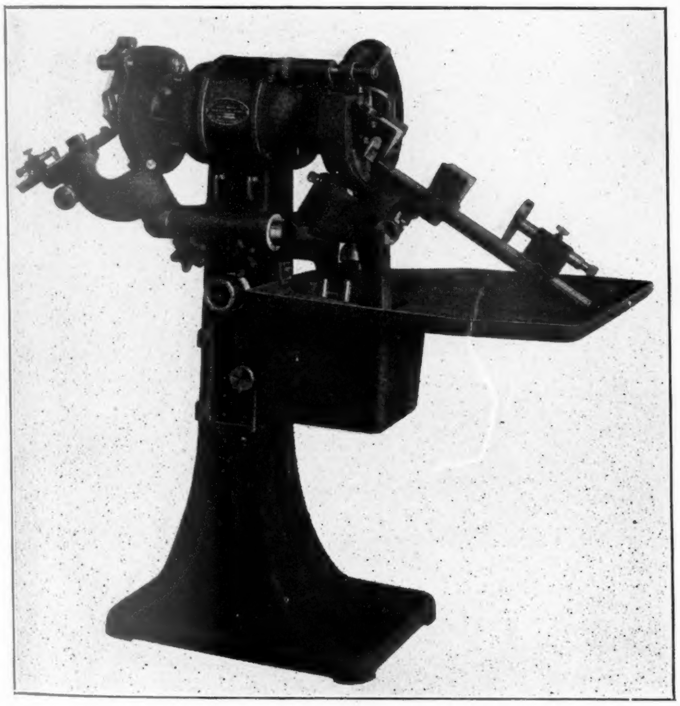
The weather-proof fitting for double push-button switches (No. 2) was designed to protect push-button switches from vapor, gas and dust. The body has four ears to which the cover is fastened. The cover is flanged, and is furnished with a mechanism which operates the push buttons and extends through the side of the dome terminating in an operating handle. That portion of the shaft to which the handle is fastened, passes through a stuffing box. The handle is marked with indicators "on" and "off."

The vapor-proof lamp outlets, Nos. 3 and 4 are fittings so designed that they remain vapor, gas or dust-proof even though the globe may be broken or removed for renewal of lamp. The guards are of the screw type, and do not require the use of a screw driver. These fittings are furnished with receptacles, sealing plates, gaskets and all necessary screws, and with or without globe and guards.

The weather-proof lamp outfit No. 5 is suitable for use in places where a small, durable fitting is required. It is furnished complete with receptacle, gasket, holder and guard. Brass guards are regularly furnished on this fitting, but steel guards can be furnished if so specified. This type is not made to take vapor-proof globes.

A REFINEMENT IN TWIST DRILL GRINDERS

THAT the agitation for "more holes for less money" has influenced the development of other factors than improved and harder steel for drills and improvement in the design and construction of the machines for driving them, is attested by the results of studies on the proper maintenance of the drills. One of the results is shown in the photograph. This is a double holder drill grinder which contains several new and time saving features, conspicuous among which is the departure from the usual practice by the furnishing of a double holder machine in



Motor Driven Double Holder Drill Grinder

which is combined a small minimum capacity convenient in handling small drills, with the necessary capacity for large drills. The smaller holder will accommodate drills from No. 52 to ¾-in., while the larger one will handle drills up to 4 in. or more. The larger holders grind the large drills wet and use a coarse wheel. The small drills are ground dry on a fine grain wheel.

In grinding drills on this machine the rotation of the wheel is downward from the point of the drill, thus obviating a tendency for the drill to lift from the holder, as well as throwing all grit downward, resulting in safety for the operator's eyes.

Extra weight has been incorporated in the main frame or column to provide for rigidity. The spindle is furnished with a ring oiled bronze bearing. Radial wear and end play are provided for and the bearing is made dustproof through the use of felt washers. The wheel guards are mounted on the stand by three substantial supports. The wheels are carried between heavy flanges to lessen danger, increase rigidity and insure good grinding results.

The lip rests furnished with these machines are flat strips of hardened steel of uniform width and thickness with slotted holes, by means of which they are held in position on the front of the holder; the screws hold them not only against the front of the holder, but automatically bring the back edge against the shoulder, which is machined in a line parallel to the correct position for the front edge. The shape is so simple that it is stated that if one of the lip rests becomes lost or damaged it can be duplicated without difficulty. A comparatively long life for the lip rests is made possible by the fact that they can be reversed, the front edge being substituted for the back edge.

An important improvement is incorporated in the wheel truing mechanism. A wheel truing diamond is carried in a member attached to the hood of the wheel which is adapted to swing across the face of the grinding wheel. The carrier for the diamond and a stop are moved in unison across the wheel by the turning of the knurled nut on the end of the spindle, which is seen just in front of and near the top of the motor in the photograph. Whatever amount is dressed off by the diamond will be automatically taken care of by the new position of the stop and when the drill holder is again brought in front of the wheel a perfect setting is obtained.

The swiveling action provided for grinding the drill is accomplished by the use of a ground stud 1½ in. in diameter by 4¼ in. long on which is journaled the cast iron swivel head with a bronze bushing bearing on the full length of the ground steel stud. The top of the bearing is covered with a plate for the exclusion of dust and dirt from the bearing surfaces. A grease cup lubricates the swivel bearing.

The grinder is particularly adapted to take care of high speed steel drills which are welded or screwed into machine steel shanks, where frequently the shanks are considerably larger than the drill. A special drill holder has been designed for left hand drills.

To accommodate the differences in the amount of clearance required on different classes of work, provision is made for rocking the drill holder in the upper swivel bearing, which rocking adjustment is controlled by turning a knurled handwheel operating a differential screw.

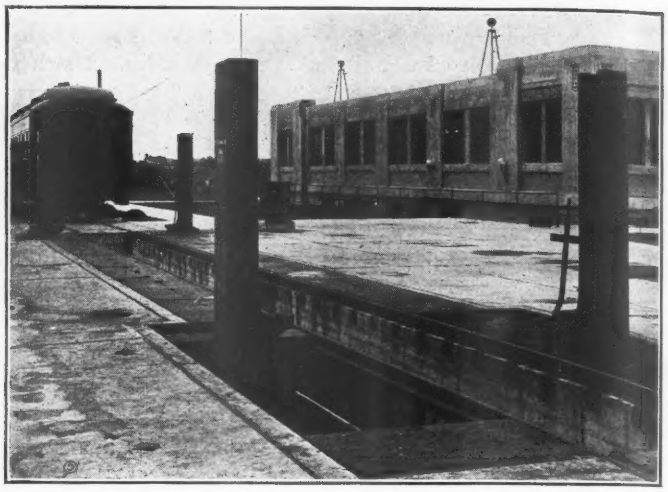
This double holder drill is characteristic of the line of grinding machines manufactured by the Grand Rapids Grinding Machine Company, Grand Rapids, Mich., who will exhibit the style C-6-A grinder mentioned, with several other models, at the June mechanical conventions at Atlantic City.

QUICK-ACTING DEVICE FOR UNWHEELING COACHES

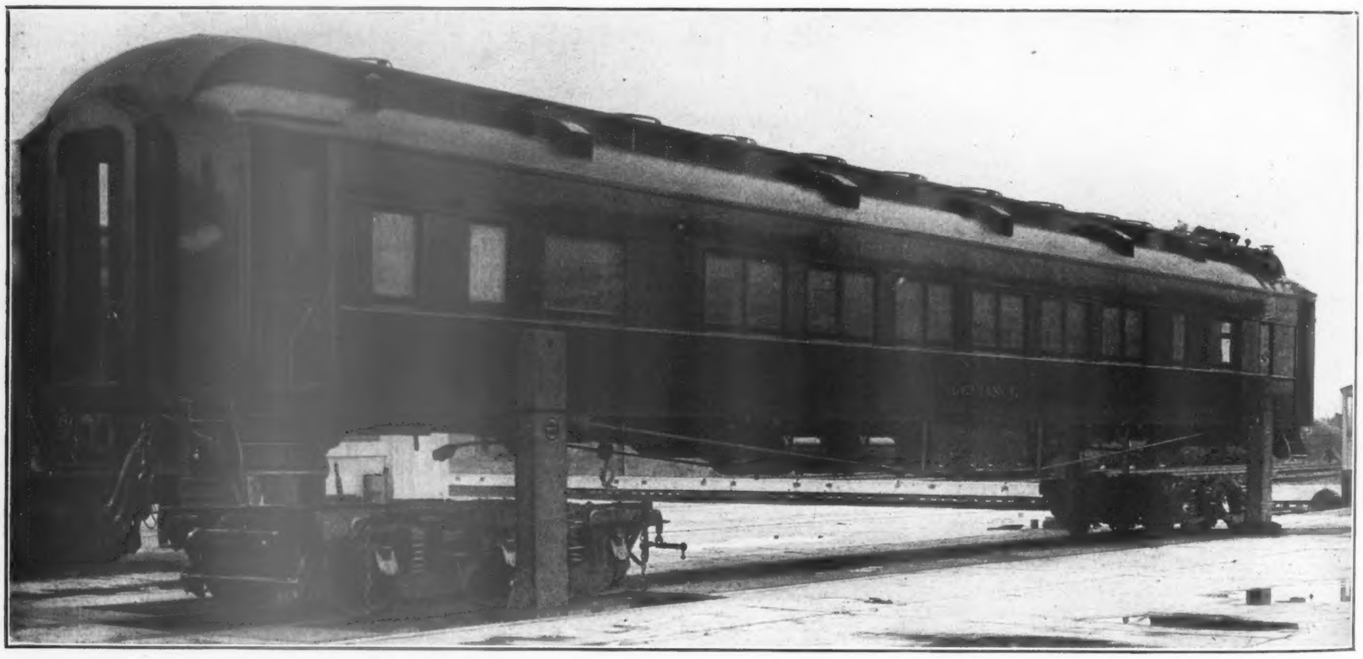
THE successful application of the principle of raising locomotives for unwheeling by means of permanently installed, electrically operated screw jacks lifting from the floor, has been extended to the car repair tracks and the illustrations give some intimation of the speed, cleanliness and general efficiency in jacking up cars preparatory to rolling out the trucks from both ends.

The electric controller box is at the right of the first pair of jacks in Fig. 1. The upright members of the jacks are spaced a fixed distance apart laterally. The near pair have the floor boards removed to show the mounting of the jacks upon a truck, which provides for adjusting their spacing longitudinally for the different lengths for cars.

The heavy steps or knees on the jacks travel between the jaws or flanges of the cast steel column or post. Each is controlled by a revolving screw, and provision is made for raising each step to the sills of the car independently; then all four jacks can, by throwing a clutch, be controlled as a unit. The equipment is manufactured by the Whiting Foundry & Equipment Company, Harvey, Ill.



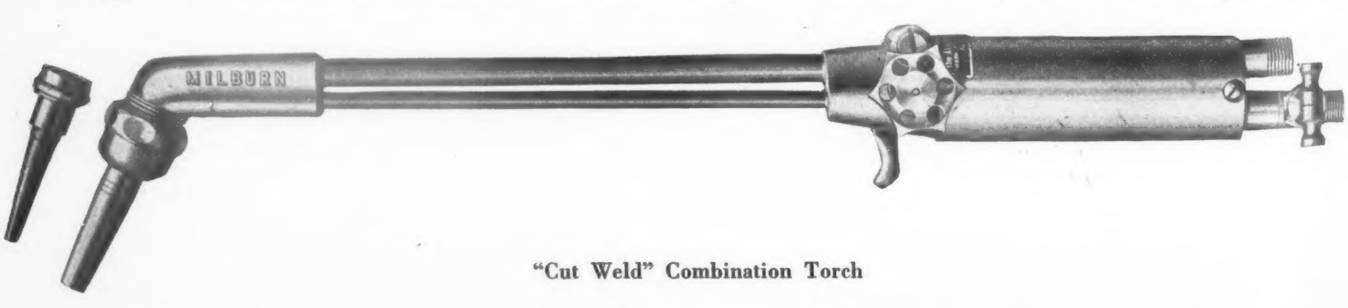
Jack for Unwheeling Coaches



Coach Raised Sufficiently for the Trucks to Be Removed

A CARBIDE LAMP AND WELDING TORCHES

THE new 5,000 candle power carbide lamp illustrated herewith is said to be able to throw a strong light from a 12-in. white enamel reflector for 12 hours with the use of 8 lb. of carbide—a cost of approximately 3c. an hour. It is equipped with a vanadium steel burner cleaner which operates from the rear while the light is burning. The container is equipped with shelves or pockets (see A) which will accommodate the rated carbide capacity of the container and no more; it has the added advantage of facilitating the quick disposal of the used carbide which can be easily dumped by



"Cut Weld" Combination Torch

Equal Pressure Welding Torch

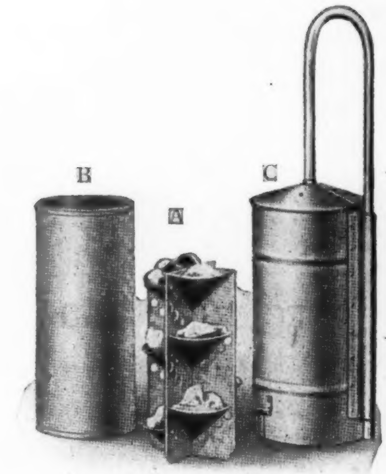
simply withdrawing the container and tapping it on the edge. The light has 10,000 candle power. It burns over 12 hours on 12 lb. of carbide, at a cost of 4 cents per hour.

The lamps are the product of the Alexander Milburn Company, Baltimore, Md., who manufacture a general line of carbide illuminating apparatus, as well as oxy-acetylene torches for welding.

The "quick-weld" torch, type J, illustrated herewith, is an equal pressure oxy-acetylene torch for welding and has only recently been produced by the same company. In this torch the gases are mixed in the tip and each size of tip has its own mixture. The torch head and tips have a flat seat which insures a perfect fit at all times, a new tip fitting the old torch without difficulty. It is provided with five different sizes of tips and is equipped with union hose couplings. This torch is known as the equal pressure welding torch because the oxygen and acetylene are used at equal pressures; this is said to make a softer flame and prevent danger of oxidation of the metal through an oversupply of oxygen; the torch is said to be non-flash-back.

The "cut-weld" torch, also illustrated, is also a new product and is an all-purpose torch with interchangeable tips which can be used for cutting or welding as the case requires.

Carbide Light



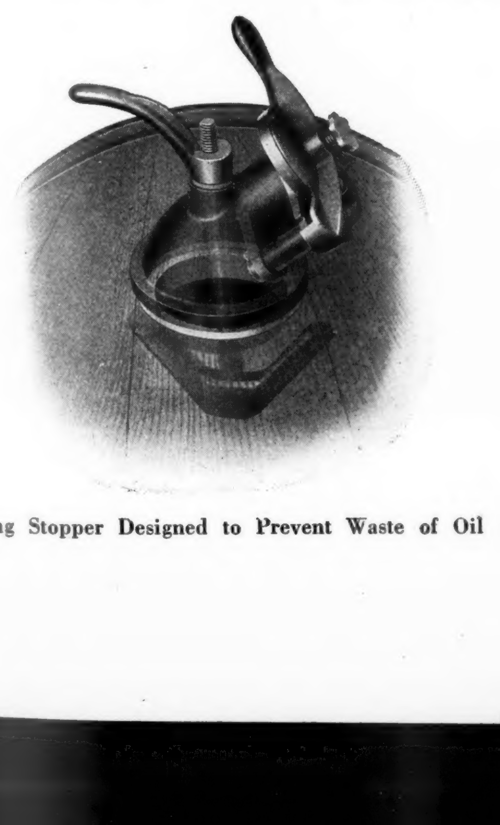
Parts of Carbide Container

OIL STORAGE AND PREVENTION OF WASTE OF OIL

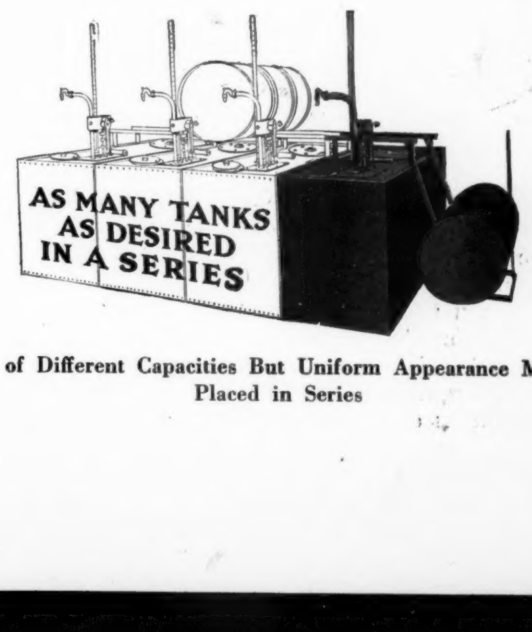
THE bung stopper, shown in the illustration, is so constructed that it may be tightly fitted in the bung hole of a barrel whose contents may then be transferred to storage tanks without the loss of a drop of oil.

The threaded main stem through the center of the body of the bung stopper, is connected to the two upturned fingers which rest against the inside of the barrel. The fingers are pivoted to the stem in such a way that they can readily be slipped through the bung hole. By tightening the hand screw at the upper end of the stem, the bung stopper is clamped to the barrel at the bung hole. When the stopper has been placed directly over the fill opening the sliding gate on the outlet of the stopper is opened. The bung stopper is a standard attachment furnished by the Milwaukee Tank Works, Inc., Milwaukee, Wis., who are also manufacturers of the storage tanks illustrated.

The battery of tanks placed in series forms an ideal method of handling oils of different kinds. All the dimensions of the tanks are the same, except for the width which varies according to the capacity. Tanks of various capacities may therefore be placed in the same series without disturbing the uniformity of appearance. The pumps which are furnished with the tanks are of standard self-measuring designs. An 18 in. manhole affords easy access for cleaning or inspection.



Bung Stopper Designed to Prevent Waste of Oil



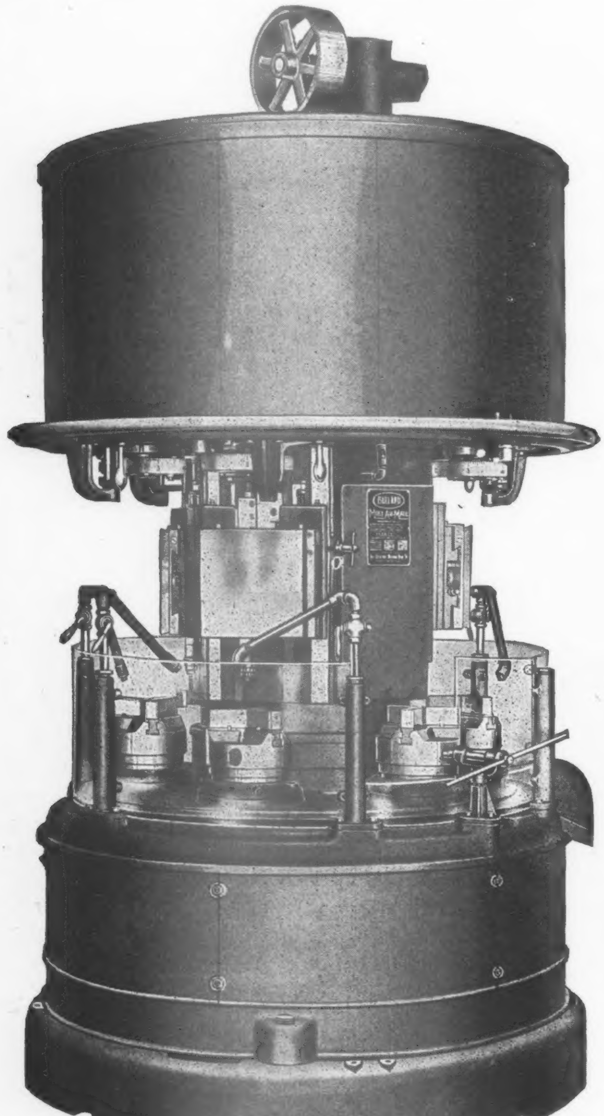
Tanks of Different Capacities But Uniform Appearance May Be Placed in Series

A BORING MILL THAT IS SIX MACHINES IN ONE

A MACHINE that is a self-contained, fully equipped factory, capable of producing the highest grade of work, correct to within a thousandth part of an inch, marks the advanced stage of multi-spindle boring mills which has been achieved in the "Mult-Au-Matic."

This machine will be exhibited in operation at the June mechanical conventions at Atlantic City with a new vertical turret lathe and the Maxi-Mill, a development of the 2-spindle boring mill, by its designers and manufacturers, the Bullard Machine Tool Company, Bridgeport, Conn.

The Mult-Au-Matic illustrated in the photographs is six engine lathes in one machine, each working in sequence and operated by one man, whose only duties consist of loading and unloading. There are five working stations, each of

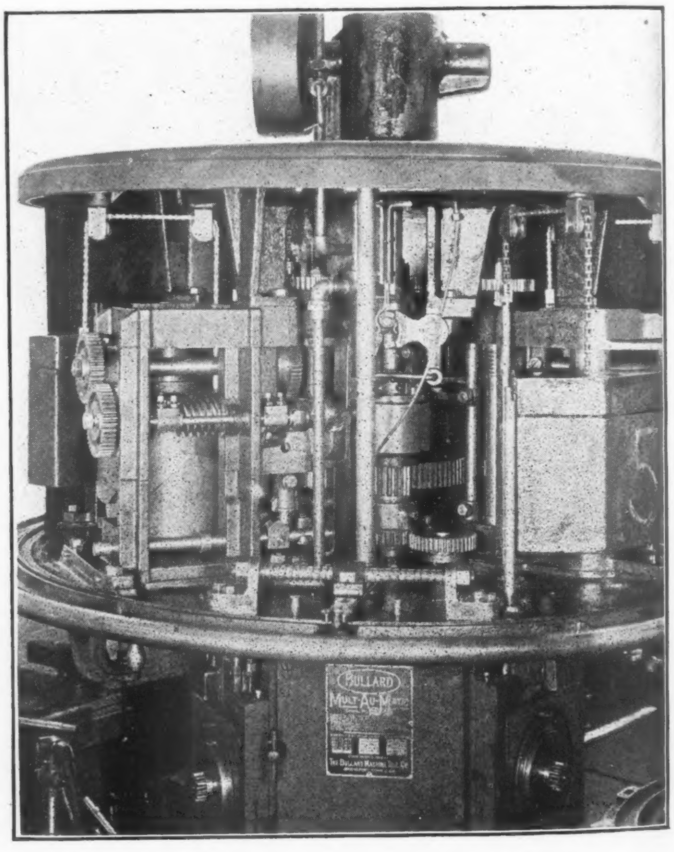


Bullard Mult-Au-Matic

which impresses the onlooker as being an engine lathe standing on its head, and working the better because of the new position, for all the humanly operated lathe motions are followed out without the mind or hand of man to guide and with slight possibility of human lapses in time and accuracy.

The field of the Mult-Au-Matic includes all classes of castings, forgings, or bar-stock sections, cut to length, coming within its capacity, and which require boring, turning, facing or threading operations, either singly or in combination. It comprises six independent vertical lathes automatically operated in combination on a series of pieces of the same form and size, all of the sequence of operations, including chucking, being performed simultaneously. Thus there is produced a completely finished piece in the time required for the largest operation of the sequence plus the few seconds needed for the indexing of the carrier and its spindles from one station to the next. The six independent work-holding spindles are mounted on a carrier, or turret, which revolves around a central column having six faces, the first of which, being the loading station, is blank. On the remaining five faces are mounted tool-carrying slides which are independently adjustable in amount, rate and direction of movement.

The cylindrical base is divided into two sections, the lower of which serves as a tank of large capacity for cutting lubricant or "Coolant" and the upper as a reservoir for the lubricating oil circulated throughout the machine. On its lower



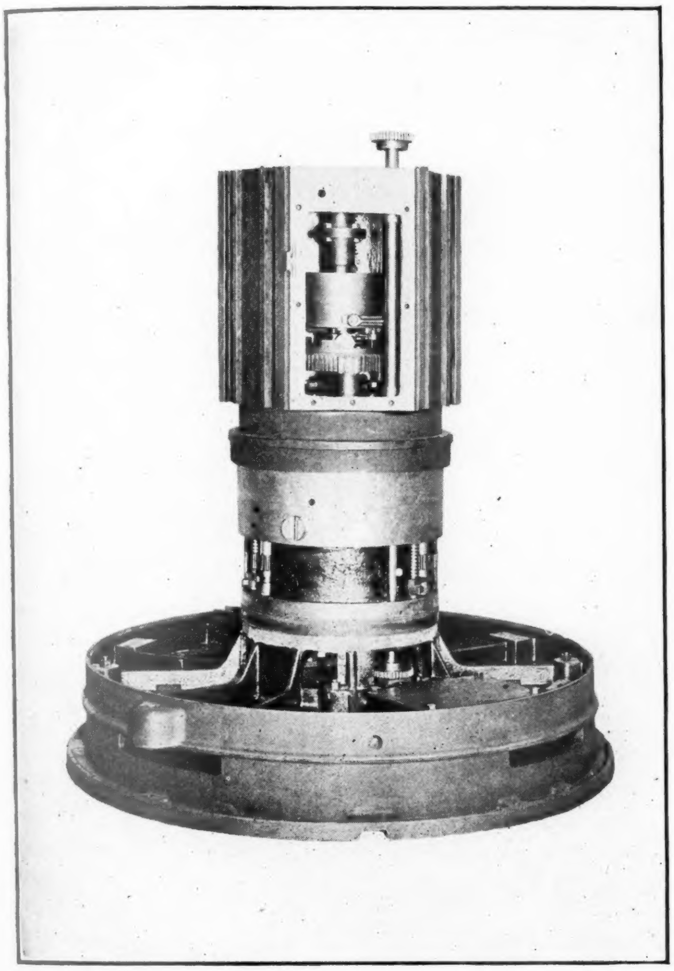
Inside View of the Upper Story of 8-Inch Mult-Au-Matic with Metal Splash Guards Removed

end is found the main, or central, bearing for the spindle carrier, or turret. This section contains the indexing or turret registry mechanism and is illustrated herewith showing an inside view of the upper section, with the sheet metal guard removed revealing the main drive shaft, the outside hand-controlled clutch ring, work spindle drive, feed change gears, quick return cam on feed head, and a view of a counterweight on one of the stations of the machine.

On its upper end are mounted the independent tool-carrying heads, and on the head of the column and firmly secured thereto is mounted a strongly ribbed base for the feed and driving mechanism.

The work spindles, in type and proportion, are somewhat

like those used in the Bullard boring mills and vertical turret lathes. Means for obtaining widely variable independent selective speeds for the work-carrying spindles are provided at each station. Speed changes are made through the transformer gears, located at the head of the column.



Base and Hexagonal Column Showing Controller Drum, Locking Pin and One of the Work Spindle Driving Pinions

The carrier is rotated from station to station by power. The tool-carrying heads are mounted on the faces of the column at the five work stations. These heads are entirely independent in direction, amount and rate of movement, and consist of a main slide gibbed to the column, on which is mounted a secondary slide to which the tool combination can be secured. The secondary slide may be swiveled to 90 degrees either way of the work axis and rigidly located at any angle.

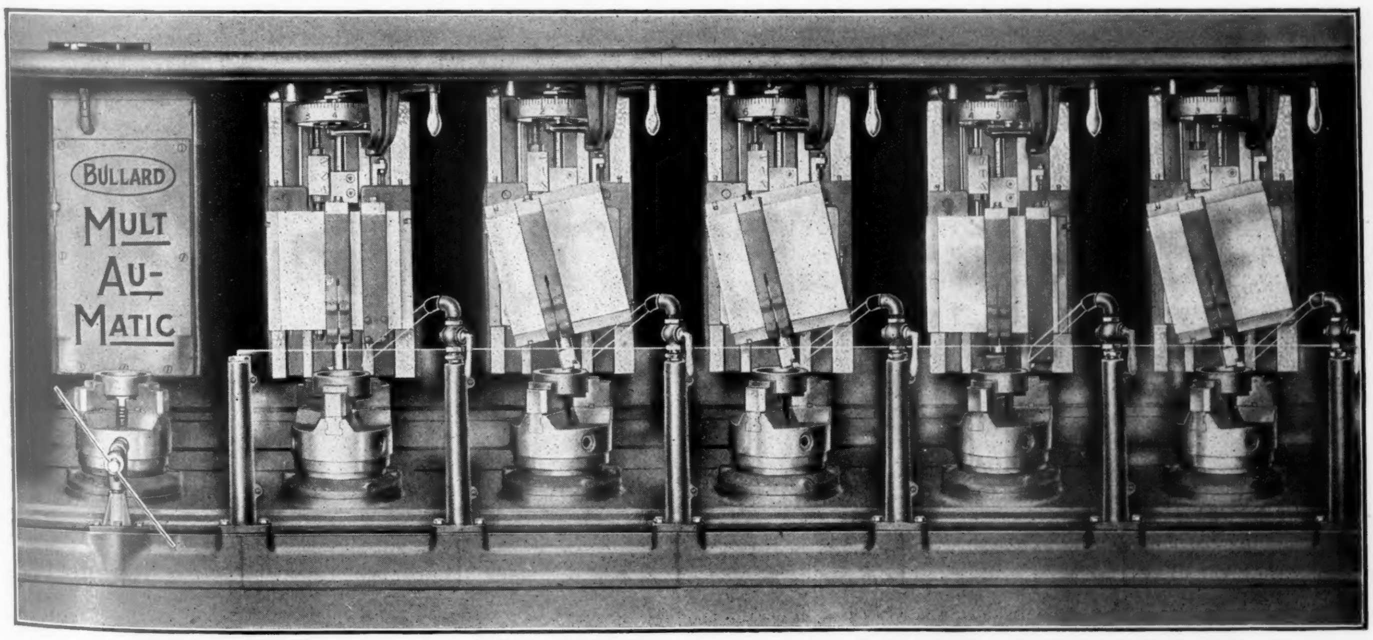
For straight boring, reaming and turning, the secondary slide is locked at zero and the entire head moves as a unit throughout the distance required to complete the operation, meets its stop and is returned.

For taper boring—an example of which is shown in one of the illustrations, a developed view of the six heads—angular turning or facing at any angle with the work axis the secondary slide, which is fed the distance required, is brought to rest by a stop and locked in position. The motion is then taken up by the secondary slide, which is fed the distance required, brought to rest by an adjustable stop and returned through its original path. The heads are rapidly advanced to the point where feed should begin, the feeds then engaged at the predtermined rate per revolution, and at the completion of the feed movement are rapidly returned. The rate of advance and return is constant regardless of feed or spindle speed, but the point of change from rapid advance to speed is adjustable.

Each tool head has also an independent manual control, saving time in the setting up of a job. The time element of all automatic motions is therefore constant and cannot be varied or adjusted by the operator.

The Mult-Au-Matic operates on a principle that makes the total time for machining a piece on it the time of the longest single operation. A feature that promotes flexibility of set-up and at the same time decreases the expense of tool equipment is the use of traverse and angular feeds. The necessity of sweep cutters for facing is done away with.

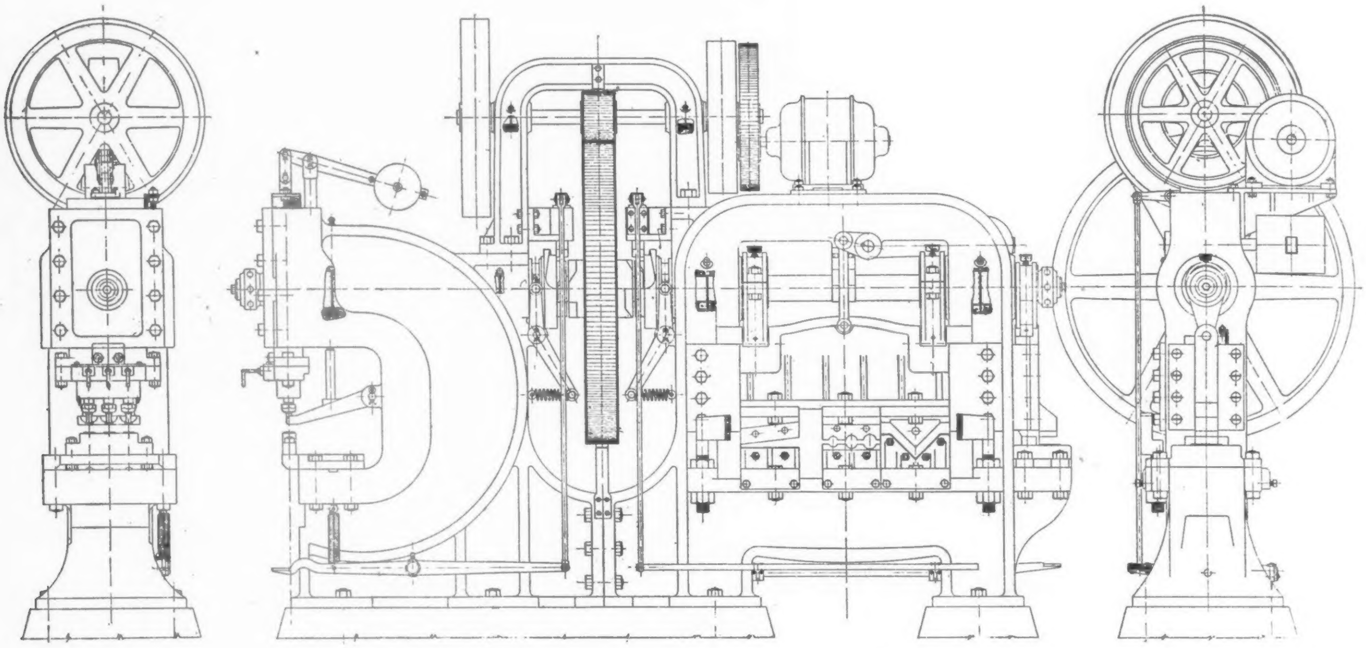
Some idea of the remarkable savings brought about by this machine may be had from the experience of a manufacturer of international renown. In his plant a Mult-Au-Matic has cut the total time for a series of different machining operations on a certain piece from 15 minutes to 2 minutes and 15 seconds. In addition to this saving in time, the work is of higher and more uniform quality.



Developed View of the Loading Station and Five Working Stations, Showing the Mult-Au-Matic Tooled for Machining a Conical Roller-Bearing Race

COMBINATION TOOL FOR THE STEEL CAR SHOP

As evidence of an increasing tendency in the construction of machine tools which, constituting one unit only, are designed to do the work of and supplant two or more independent installations, a recent addition to the motor-driven heavy punch and shear line is shown in the illustration. It was specially designed for use in car repair shops.



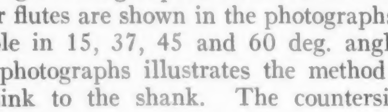
Combination Punch and Shear Especially Designed for Steel Car Repair Work

The left hand or punching end of the machine is equipped with a semi-steel architectural jaw for handling structural shapes; the throat depth can be furnished in any required practicable dimension. Three different sizes of punches can be set up simultaneously and each may be operated independently at the option of the operator. The right hand end of the machine comprises a semi-steel guillotine frame supporting and operating three different types of shears; one for flat work, one for different sizes of round bars and another for angle irons, while the extreme right end of the machine contains a set of coping tools. Seven sets of tools, each set ready for instant use, constitutes the working range of this interesting combination; it will be recognized that in overcoming the loss of time incident to the setting up of various tools as generally required in the operation of the simple double-ended punch and shear, a marked advantage has been gained. The frame of the machine is of semi-steel; the bearings are of phosphor bronze with ring oilers; the clutches are fitted with automatic release.

This machine, furnished in several sizes, will be exhibited at the June mechanical convention at Atlantic City by its manufacturers, the Beatty Machine & Manufacturing Company, Hammond, Ind. It is arranged for motor drive, as indicated in the drawing, all of the driving mechanism being mounted on the head.

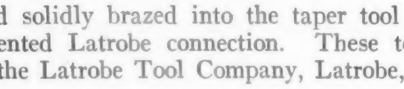
HIGH SPEED STEEL COUNTERSINKS

New designs of high speed steel countersinks with three or four flutes are shown in the photographs and are obtainable in 15, 37, 45 and 60 deg. angles of points. One of the photographs illustrates the method of attaching the countersink to the shank. The countersink is firmly



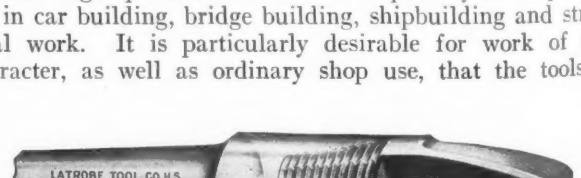
Latrobe Countersink with Four Flutes

screwed and solidly brazed into the taper tool steel shank with a patented Latrobe connection. These tools are the product of the Latrobe Tool Company, Latrobe, Pa., a subsidiary of the Vanadium-Alloys Steel Company, Pittsburgh, Pa.



Latrobe Countersink with Three Flutes

These high-speed countersinks were specially developed for use in car building, bridge building, shipbuilding and structural work. It is particularly desirable for work of this character, as well as ordinary shop use, that the tools be made of material of such toughness and hardness that they will stand up under rough usage. These countersinks are said to give maximum efficiency on the hardest material.



Showing How Countersinks Are Attached to Shanks

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 12,000 copies were printed; that of these 12,000 copies 8,007 were mailed to regular paid subscribers, 80 were provided for counter and news company sales, 202 were mailed to advertisers, 27 were mailed to employees and correspondents, 1,000 were provided for distribution in Atlantic City during the convention of the Mechanical Section, American Railroad Association, 601 for new subscriptions, and 2,083 were provided for samples, copies lost in mail and office use; that the total copies printed this year to date were 52,610, an average of 8,768 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

War Cost of Railway Equipment

For the information of the Liquidation Commission, the office of the chief of engineers has prepared an estimate of the costs of railroad equipment shipped to the A. E. F. computed on the basis of 1914 prices. The government actually paid from two to two and a half times the pre-war costs.

UNIT COST OF STANDARD GAGE RAILWAY EQUIPMENT COMPARED WITH PRE-WAR COST

	Shipped to A. E. F.	Unit price: Pre-war	Unit price: Actual	Actual cost in per cent of pre-war cost
Locomotives—				
Consolidation	1,306	$17,500	$42,966	245
Gasoline	10	9,350	22,000	235
Saddle tank	30	4,500	9,700	216
Total	1,346	....	....	...
Cars—				
Tank	675	$1,367	$3,397	248
Gondola, l. s.	3,429	1,090	2,340	215
Flat	1,900	982	2,107	215
Box	7,299	1,290	2,755	214
Refrigerator	950	1,649	3,489	212
Gondola, h. s.	2,650	1,155	2,430	210
Dump	500	1,026	2,108	206
Ballast	400	1,454	2,987	205
Box, with cab	500	1,366	2,770	203
Total	18,303	....	....	...

COST OF STANDARD GAGE RAILWAY EQUIPMENT COMPARED WITH PRE-WAR COST

	Pre-war cost	Actual cost	Actual cost in per cent of pre-war cost
Locomotives	$23,083,500	$56,524,870	245
Cars	22,346,745	48,822,100	214
Total	$45,430,245	$105,346,970	230

Surplus Military Railway Equipment

The War Department has given out the following statement of the amount and value of property on hand or on order available for sale. The figures are as of May 1:

	Number	Total cost
Standard gage locomotives	197*	$7,540,175
Standard gage freight cars	12,404†	27,621,536
Locomotive cranes	195††	3,924,938
Raised pier cranes	34†	652,960
Track pile drivers	18	603,000
Total	....	$40,342,609

*All on hand.
†None delivered.
††Forty-six not yet delivered.

The locomotive and raised pier cranes will be turned over to the Railroad Administration, by arrangement with the director general of railroads, for sale to the railroads. Under the arrangement with the Railroad Administration the director general will use every effort to dispose of the property to the several railroads at market prices at the time and place at which disposition is made. The incidental expenses incident to the care of the material are to be taken from the proceeds of the sale.

This arrangement also covers about 1,366 tank cars purchased by the Ordnance Department, 100 twelve-yard and 1,320 twenty-yard side dump cars, all of which are fitted to comply with Master Car Builders' and Interstate Commerce Commission standards. In the event of termination of federal control of the railroads before this material is entirely disposed of, the material remaining at the time is to revert to the War Department's possession but in all cases where the material has been sold by the Railroad Administration on the deferred payment plan the War Department will protect such arrangements after the federal control of the railroads ceases.

This entire transfer covers approximately $18,000,000 worth of material. The distribution of the property to the railroads will be handled by the director of the Division of Purchases.

The sales of surplus supplies by the department of military railways, as reported to the director of sales up to April 25, amounted to $71,104,130, of which $68,993,837 represented rolling stock. The prices received represented the actual original cost.

Record of the Engineer Corps

A resumé of the work of the Engineer Corps of the American Expeditionary Forces has been issued by the office of the chief engineer of the A. E. F. and is included in Engineering Recruiting Circular No. 2 used by army recruiting officers in their campaign for volunteers. The circular states that there were 174,000 engineer troops in the service. Part of the work done by the railway engineering units in this force consisted of the construction of 947 miles of standard gage track and a six mile cut-off at Nevers requiring a bridge across the Loire river, 2,190 ft. long.

Among the accomplishments of this force are listed many records in the construction and operation of military railroads. The light railways of the American Expeditionary Forces handled to February 1, 860,652 tons of freight, of

which 166,202 tons was ammunition. In one week the ammunition moved amounted to 10,600 tons, and in five nights 23,135 soldiers were carried on these railways. The daily net tonnage handled in October, 1918, was 8,100 tons. In one week 10,700 tons of rations were handled. At the time of the signing of the armistice 2,240 kilometers (1,392 miles) of light railway were in operation, of which 1,740 kilometers had been taken from the Germans, the balance being newly constructed or rebuilt. On November 11, 165 locomotives and 1,695 cars were available for use. In five hours 135 men laid 14,200 ft. of light railway track. Among the shops erected were 10 buildings at Abainville, with a total floor area of 70,000 sq. ft. Over 2,300 cars have been erected and 140 locomotives have been repaired in these shops.

R. H. Aishton, regional director of the Northwestern region, in a telegram to Northwestern roads states that locomotive builders are urging the placing of orders for locomotives in order that they may keep their shops in operation, and also keep down the overhead cost of the locomotives that have been or will be built. The telegram asks for information as to the number and type of additional U. S. standard locomotives that will be required on lines in this region and whether or not approved by the railroad corporation. If the corporations are not willing to buy the United States standard type they are asked to give the number and the type or types that they will be willing to purchase of their own standard.

The American Railroad Association has moved its Chicago offices from the Transportation building, 608 South Dearborn street, to the Manhattan building, 431 South Dearborn street, where the entire fourteenth floor has been secured for its offices and those of the railway associations which have been merged or affiliated with it. The office of the secretary of the Master Mechanics' and Master Car Builders' associations heretofore in the Karpen building, has been moved to the same building.

The Inspection and Test Section of the Railroad Administration is considering the question of tests of locomotive specialties, such as bell ringers, firedoors and electric headlights, and would be glad to receive full information from the various manufacturers desiring to participate in the tests. Communications should be addressed to C. B. Young, manager, Room 709, 1800 Pennsylvania avenue, Washington, D. C.

MEETINGS AND CONVENTIONS

Western Railway Club.—The Western Railway Club on May 19 elected the following officers: President, G. S. Goodwin, mechanical engineer, C., R. I. & P.; first vice-president, J. Purcell, assistant to federal manager, A., T. & S. F.; second vice-president, E. J. Brennan, superintendent of motive power, C., M. & St. P.; secretary-treasurer, J. M. Byrne, chief clerk to mechanical assistant, Central Western Region; directors, E. B. Hall, assistant superintendent of motive power and car department, C. & N. W.; L. S. Kinnaird, superintendent of motive power, C. & E. I.; W. H. Flynn, superintendent of motive power, Michigan Central.

American Society for Testing Materials.—This association will hold its twenty-second annual meeting at the Hotel Traymore, Atlantic City, N. J., on June 24, 25, 26 and 27. Among the features of special interest to railway men as outlined in the tentative program are a session on preservative coatings, lubricants and containers on Tuesday afternoon; a session on steel and wrought iron on Wednesday forenoon; one on Wednesday evening on corrosion and magnetic analysis, and one on concrete and gypsum, including the report of the committee on reinforced concrete, on Friday afternoon. The convention will close with a joint session on cement and concrete with the American Concrete Institute. This will be held on Friday evening, June 27.

Air Brake Appliance Association.—An organization of manufacturers of air brakes and accessories, for supervising the exhibits in connection with conventions of air brake associations, was formed at a meeting held in the Hotel Sherman, Chicago, May 7. At this meeting a constitution and by-laws were adopted and the name, Air Brake Appliance Association, chosen. The following officers were elected: Chairman, J. J. Cizek, The Leslie Company; secretary-treasurer, F. W. Venton, Crane Company. Members of the executive committee for three years: J. F. Gettrust, Ashton Valve Company; J. C. Younglove, H. W. Johns-Manville Company; J. D. Wright, Westinghouse Air Brake Company. Members of the committee for two years: F. W. Venton, Crane Company; J. H. Dennis, New York & New Jersey Lubricant Company; L. H. Snyder, Joseph Dixon Crucible Company. Members of the executive committee for one year: J. J. Cizek, The Leslie Company; M. S. Brewster, U. S. Metallic Packing Company; D. S. Prosser, U. S. Rubber Company.

Twenty-one supply companies exhibited devices at the Air Brake Association convention this year.

Atlantic City Mechanical Convention.—The American Railroad Association has issued the calendar for the first annual convention of Section III—Mechanical, which is to be held at Atlantic City, N. J., June 18 to 25. The order of business is as follows:

Wednesday, June 18, 9:30 *A. M. to* 1:30 *P. M.*

Prayer; address of welcome by the mayor of Atlantic City; address by the chairman.

Action on minutes of annual meeting of 1918 (M. C. B.); report of secretary and treasurer (M. C. B.).

Appointment of committees on subjects, resolutions, correspondence, obituaries, etc.; unfinished business; new business.

Report of general committee, including announcement of nominations for members of nominating committee; discussion of reports on nominations; standards and recommended practice (M. C. B.); train brake and signal equipment; brake shoe and brake beam equipment.

Wednesday, 3 *P. M.*

Revision of the Rules of Interchange, including consideration of the following reports of committees: (1) Arbitration; (2) Revision of prices for labor and material; (3) Depreciation for freight cars; (4) Revision of passenger car rules of interchange.

Thursday, 9:30 *A. M. to* 1:30 *P. M.*

Discussion of reports on car wheels; standard blocking for cradles of car dumping machines; specifications and tests for materials (M. C. B.); welding truck side frames, bolsters and arch bars; couplers; draft gear.

Questions proposed by members.

Friday, 9:30 *to* 1:30.

Discussion of reports on safety appliances; loading rules; car construction; car trucks; train lighting and equipment; tank cars.

Questions proposed by members.

Saturday, 9:30 *to noon.*

Consideration of rules of order, election of officers, general committee and nominating committee, presentation of badges to retiring officers, etc.

Monday, June 23, 9:30 to 1:30.

Address of vice-chairman; action on minutes of 1918 annual meeting (M. M.); reports of secretary and treasurer (M. M.).

Discussion of reports on standards and recommended practice (M. M.); mechanical stokers.

Paper on "Standardization," by Frank McManamy.

Questions proposed by members.

Tuesday, 9:30 to 1:30.

Discussion of reports on fuel economy and smoke prevention; specifications and tests for materials (M. M.); design and maintenance of locomotive boilers; locomotive headlights; superheater locomotives.

Paper on carbonization in valve chambers and cylinders of superheated steam locomotives, by F. P. Roesch.

Amalgamation of other mechanical associations with Section III, A. R. A.

Questions proposed by members.

Wednesday, 9:30 to 1:30.

Discussion of reports on design, maintenance and operation of electric rolling stock.

Paper on "Use of bronze for valve snap rings and piston surfaces, and for bull rings in large cylinders," by C. E. Fuller.

Discussion of reports on train resistance and tonnage rating; on subjects; on resolutions, correspondence, etc.

Unfinished business; questions proposed by members and closing exercises.

Arrangements have been made for a special train to accommodate railroad men from Chicago and points west who will attend the convention. The train will leave Chicago at 3 p. m., June 16, and will arrive at Atlantic City about 5 p. m., June 17. It will have club and dining cars, 12-section drawing room sleepers and 7-compartment drawing room cars. Requests for reservations on this train should be addressed to C. L. Kimball, 175 W. Jackson boulevard, Chicago.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, New York, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-3, 1919. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 18-21, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y.—Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

S. A. CHAMBERLAIN has been appointed superintendent of motive power of the Lake Superior & Ishpeming and the Munising, Marquette & Southeastern, with headquarters at Marquette, Mich.

MAJOR C. E. LESTER of Meadville, Pa., has been appointed general superintendent of the 19th Grand Division, Transportation Corps, of the American Expeditionary Force. He entered the National Guard, 13th Pennsylvania Infantry, in August, 1916, and was commissioned first lieutenant, infantry, in October of the same year. In August, 1917, he was transferred to the engineers. He was appointed captain, engineers, in the National Army in April, 1918, and commanding officer of the 50th Engineers, with which he went abroad in July, 1918. Upon his arrival in France he was appointed general foreman at the Nevers locomotive shops, operated entirely by United States soldiers. He subsequently served as assistant superintendent of the same shops and then as acting general superintendent of the 19th Grand Division until his appointment as general superintendent of the same division. Major Lester was formerly general foreman boiler maker on the Erie at Meadville, Pa., from April, 1906, to January, 1911, and was assistant master mechanic on the Baltimore & Ohio at Pittsburgh, Pa., until March, 1912, when he returned to the Erie as foreman boiler maker at Jersey City. From July, 1912, to July, 1914, he was assistant foreman in the tank shop of the American Locomotive Company at Dunkirk, and then was inspector with the Lima Locomotive Works at Lima, Ohio, and from February, 1915, to August, 1916, was boiler maker foreman on the Lehigh Valley at Sayre, Pa.

J. W. OPLINGER, superintendent of motive power of the Second and Third divisions of the Atlantic Coast Line, with headquarters at Waycross, Ga., resigned on May 1. He entered the service of the Central of New Jersey on March 1, 1874, as a machinist apprentice and after completing his apprenticeship in 1878, served as a machinist until 1880 on the same road. He then went to the Lehigh Valley as a machinist at Wilkes-Barre, Pa., and four years later left that road to go to the Atchison, Topeka & Santa Fe, in New Mexico, remaining in the service of that road until 1887. He then returned to the Central of New Jersey as gang foreman, and later was erecting foreman on that road. In 1894 he served as general foreman on the New York, Susquehanna & Western, and in 1900 was appointed master mechanic on the Atlantic Coast Line. Four years later he was promoted to superintendent of motive power of the Second and Third divisions, with office at Savannah, Ga., and since 1910 at Waycross, Ga., from which position he resigned to retire to his farm in Pennsylvania.

H. L. WORMAN, master mechanic of the St. Louis-San Francisco, with office at Memphis, Tenn., has been appointed assistant superintendent of motive power, with headquarters at Springfield, Mo.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

C. E. ALLEN, general master mechanic of the Northern Pacific, at Livingston, Mont., has been appointed general master mechanic of the lines east of Mandan, N. D., with headquarters at St. Paul, Minn., succeeding T. J. Cutler.

T. J. CUTLER, general master mechanic on the Northern Pacific, with headquarters at St. Paul, Minn., has been trans-

ferred to Livingston, Mont., with jurisdiction over the lines from Mandan, N. D., to Paradise, Mont., succeeding C. E. Allen.

G. R. WILCOX, assistant master mechanic of the St. Louis-San Francisco at Monett, Mo., has been appointed master mechanic of the Southern division, with headquarters at Memphis, Tenn., succeeding H. L. Worman. Mr. Willcox was born at Winfield, Kan., on September 10, 1879, and after graduating from high school attended the State Normal School at Stuttgart, Ark., for two years. In January, 1900, he entered railroad service as a machinist with the St. Louis Southwestern, and later worked in that capacity for the St. Louis, Iron Mountain & Southern at Bearring Cross, Ark., and for the Illinois Central at Memphis, Tenn. From the latter part of 1906 to the early part of 1907 he was division foreman of the St. Louis, Iron Mountain & Southern at Cotter, Ark., but in 1907 he came to the St. Louis-San Francisco as machinist and in September, 1908, was promoted to night roundhouse foreman. In July, 1909, he was appointed machine shop foreman, in 1911 general foreman and in July, 1913, was transferred to Birmingham, Ala., as general foreman. From February, 1914, to January, 1916, he acted as assistant foreman of the South roundhouse at Springfield, Mo., from January, 1916, to February, 1917, was general foreman at Ft. Scott, Kan., and from that time until April, 1919, he acted as assistant master mechanic at Neodesha, Kan., Sapulpa, Okla., and Monett, Mo. On the latter date he received his appointment as master mechanic of the Southern division, with headquarters at Memphis, Tenn.

SHOP AND ENGINEHOUSE

H. H. MAXFIELD, formerly superintendent of motive power of the New Jersey division of the Pennsylvania Railroad, with headquarters at New York, who was granted a furlough to enter military service, as an officer in the 9th Engineers, National Army, in July, 1917, has returned to the service of the Pennsylvania as acting works manager, with office at Altoona, Pa., in charge of the Altoona shops, comprising the Altoona machine shops, the Altoona car shops, the Juniata shops and the South Altoona foundries. This is a new position recently created on the Pennsylvania Railroad, Eastern Lines. Mr. Maxfield reports to the general superintendent of the Eastern Pennsylvania division and the superintendent of motive power of that division has been relieved of the jurisdiction over the above-named plants. While in France Mr. Maxfield was superintendent of motive power of the Transportation Corps, American Expeditionary Force.

PURCHASING AND STOREKEEPING

J. E. ANDERSON, purchasing agent of the Ft. Worth & Denver City; the Ft. Worth & Rio Grande; the Gulf, Colorado & Santa Fe.; the International & Great Northern; the Missouri, Kansas & Texas; the Missouri, Kansas & Texas of Texas, and the Texas Midland, with office at Dallas, Texas, has been appointed assistant purchasing agent of the St. Louis-San Francisco; the Kansas City, Clinton & Springfield; the Paris & Great Northern; the West Tulsa Belt, and the Rock Island-Frisco Terminal, with headquarters at St. Louis, Mo.

C. Z. HUGHES has been appointed purchasing agent of the Ann Arbor Railroad, with office at Toledo, Ohio.

OBITUARY

EDWARD LAWLESS, master mechanic of the Illinois Central at Freeport, Ill., died at his home on March 9, at the age of 51. Mr. Lawless had been in the employ of the Illinois Central at Freeport since 1890, when he entered it as a machinist. He was promoted a number of times, and in October, 1917, was appointed master mechanic.

SUPPLY TRADE NOTES

J. S. Cullinan has been elected president of the Galena Signal Oil Company, New York.

The Nathan Manufacturing Company, New York, has opened new offices in Chicago in the Great Northern building, 20 West Jackson boulevard, room 707, with R. Welsh in charge.

Joseph Douglas Gallagher, director, vice-president and general counsel of the American Brake Shoe & Foundry Company, New York, died at his home in Glen Ridge, N. J., on May 20, at the age of 65. He was educated at Princeton University and at Ohio Wesleyan University, Delaware, Ohio. He was engaged in the practice of law in Newark, entering the firm of Whitehead & Gallagher, which later became Gallagher & Richardson. Mr. Gallagher became director and vice-president of the American Brake Shoe & Foundry Company when it was organized about eighteen years ago, and during the last four years was also its general counsel. This company did much work on munitions for the United States Government during the war, and overwork in this connection probably hastened Mr. Gallagher's death, which followed an operation in the Morningside Hospital.

J. D. Gallagher

F. J. Foley, recently appointed general sales agent of the Railway Steel-Spring Company, New York, as was announced in these columns last month, was born in Chillicothe, Ohio, on May 14, 1879. He entered the service of the Baltimore & Ohio at Newark, Ohio, as a messenger in 1892, and then until 1897, was telegraph operator and despatcher on various roads in the West. He entered the manufacturing department of the Pullman Company at Pullman, Ill., in 1897, where he remained until 1900, when he became connected with the Steel Tired Wheel Company, which company was subsequently absorbed by the Railway Steel-Spring Company in 1902. Mr. Foley has been successively manager of all of its various spring plants, and while he has occupied the position of general superintendent of the company since 1912, during much of this time he was closely associated with the sales department.

F. J. Foley

George L. Fowler, consulting mechanical engineer, has moved his office from 83 Fulton street to 120 Liberty street, New York.

Ross F. Hayes has been appointed general sales manager of the Curtain Supply Company, Chicago. Mr. Hayes has been eastern manager of the company for 12 years, with headquarters at 50 Church street, New York, and will continue to act as eastern manager and retain his office in New York. Mr. Hayes was born at Lewiston, Me. He entered the service of the Boston Woven Hose & Rubber Company in 1888, remaining with that company for 16 years. He was a salesman in the rubber goods department in New England and New York state until 1893; and then served consecutively as city sales manager of the St. Louis branch for two years; New England representative of the bicycle tire department for two years; southern representative of the mechanical rubber goods department for two years, and as manager of the Philadelphia office until 1904. He then entered the service of the Curtain Supply Company, Chicago, as western representative, and since 1907 served as eastern manager of the company.

R. F. Hayes

Frank H. De Brun has been appointed mechanical engineer in charge of design and improvement for Mudge & Co., Chicago. Mr. De Brun was born in Switzerland in 1883 and received his education in the Higher Polytechnic University of Geneva. After graduation from that institution he served three years as an apprentice in mechanical and electrical laboratories in Switzerland and the following two years as a mechanical draftsman for the Coventry Motor Works, Ltd., at Coventry, England. The next seven years he was in the employ of the Royal Automobile Club of London, England, as superintendent in charge of garage and repairs, resigning from that position to come to the United States as manager of the Universal Auto Training School in New York City, where he remained for two years. In the fall of 1917 Mr. De Brun became associated with the Detroit Institute of Technology, where he had charge of the automotive engineering laboratories work, electrical equipment and battery work and special courses in the maintenance and repair of tractors.

F. H. De Brun

The Van Dorn Electric Tool Company, Cleveland, Ohio, has opened a Chicago office at 527 South Dearborn street, in charge of William Cottrell, sales manager.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has moved its Philadelphia, Pa., sales office from 1020 Arch street to the Finance building, South Penn Square.

The Southern Railway Car Company has been organized at Wichita Falls, Texas, with James A. Jones, president, to make tank, railway and street cars; also to repair cars.

The Booth-Hall Company, designers and builders of electric furnaces, has removed its executive and sales offices from 2307-15 Archer avenue, Chicago, to the Hearst building, 326 West Madison street.

The Baldwin Locomotive Works has recently established a separate department for handling foreign sales in charge of F. de St. Phalle, recently elected vice-president, and Reeves K. Johnson is manager of foreign sales.

At the annual election by the board of directors of the Safety Car Heating & Lighting Company, New York, W. L. Conwell was made president of the company; J. A. Dixon, Randolph Parmly and James P. Soper, vice-presidents; C. W. Walton, secretary and treasurer, and William Stewart, assistant secretary and assistant treasurer. W. L. Conwell, president, has been connected with the company since January, 1916. He was born at Covington, Ky., on January 25, 1877. He received his education in the public schools of Philadelphia and at the University of Pennsylvania, from which he graduated in 1898 with the degree of electrical engineer. He then passed the examination for first assistant engineer for the United States Navy, but received no appointment because of the close of the war with Spain. He was employed in contracting work as a timekeeper for the Tennis Construction Company, Philadelphia, becoming later chief engineer and secretary of the company. In 1901 he resigned to become city salesman of the Westinghouse Electric & Manufacturing Company in New York. He was later placed in charge of the isolated plant department of the company, and for five years, ending in 1911, was engaged in railway work. In that year he became vice-president of the Transportation Utilities Company, and later became also treasurer of the same company. In January, 1916, he was appointed assistant to the president of the Safety Car Heating & Lighting Company, and upon the death of R. M. Dixon, former president of that company in October, 1918, Mr. Conwell was made acting president. His headquarters are in New York.

W. L. Conwell

The American Steam Conveyor Corporation, Chicago, has appointed N. B. Stewart district representative in charge of its St. Louis territory. Offices have been opened at 708 Merchants-LaClede building, St. Louis, Mo.

T. W. Holt, superintendent of shops of the Pressed Steel Car Company, Pittsburgh, Pa., who had entire charge of the munition work undertaken by that company, has resigned to become assistant general manager of the Curtain Supply Company, Chicago, succeeding the late R. S. Reynolds.

George W. Hoover, formerly in charge of the procurement of railway material in the Construction Division of the army,

has been appointed manager of the St. Louis office of the Buda Company, Chicago, which office was opened on April 1 at 2025 Railway Exchange building.

The Clark Equipment Company, manufacturers of "Celfor" drills and precision tools, has just completed a modern hospital at its plant in Buchanan, Mich. The hospital is intended primarily for the use of employees, but is also open to citizens of the community at cost.

J. N. Ebling, recently returned from France, after spending 13 months with the American Expeditionary Forces, has resumed his position as president of the Railway Specialties Corporation, New York. D. A. Munro, formerly secretary, is no longer connected with the corporation.

The Duntley-Dayton Company, Chicago, has opened a branch office in the Century building, Cleveland, Ohio, under the management of J. C. Sague. This company has also opened a branch office in the Home Trust building, Pittsburgh, Pa., under the management of W. M. Hankey.

Frank H. Clark, formerly general superintendent of motive power of the Baltimore & Ohio, has opened offices at 15 Park Row, New York, and will undertake engineering investigations, report upon railway conditions and operations and prepare or cooperate in the preparation of plans and specifications for railway equipment and materials. He will also act in an advisory capacity to export firms and to foreign railway or other concerns purchasing equipment or material from manufacturers in the United States, and make such inspections as may be desired. Mr. Clark was associated for four years with David L. Barnes, consulting engineer, of Chicago, after which he entered the service of the Chicago, Burlington & Quincy, where he held successively the positions of chief draftsman, mechanical engineer, superintendent of motive power and general superintendent of motive power. He resigned his position with that company on December 30, 1910, to enter the service of the Baltimore & Ohio as general superintendent of motive power and held that position for eight years. He is a member of the American Society of Mechanical Engineers, the Franklin Institute and other technical societies. He is also a member of the American Railway Master Mechanics' Association and of the Master Car Builders' Association. He served as president of the M. M. Association for the early part of the term 1918-1919 and of the M. C. B. Association in 1910-1911.

F. H. Clark

The American Railway Equipment Company, Pittsburgh, Pa., on May 26, located its general offices in the Liberty building, Philadelphia, Pa., where G. W. Mingus, president of the company, will have his office. The company will retain an office in the Diamond Bank building, Pittsburgh, in charge of R. C. Crawford.

W. J. Cromie, who has of late years been with the Belmont Packing & Rubber Company, became associated with the Gustin-Bacon Manufacturing Company, 1021 Filbert street, Philadelphia, Pa., on May 1. Mr. Cromie was formerly connected with the B. & O. and the D. L. & W.

Lieut. Joseph P. Schneider, who for the past nine months has been on duty with the Railway Transportation Corps, U. S. A., as railway transportation officer with headquarters at Paris, France, has received his honorable release from the service and has resumed his duties as Western office assistant with the Locomotive Superheater Company at Chicago.

C. D. Barrett, who has just returned from France after 18 months' service as an officer in the Transportation Corps of the American Expeditionary Force, has been appointed district engineer of the Locomotive Stoker Company, with headquarters at New York. He was born in Fort Wayne, Ind., and after graduation from Purdue University in 1901, he entered the service of the Pennsylvania Railroad as a special apprentice at Altoona. He remained with the Pennsylvania in the positions of motive power inspector, foreman, assistant master mechanic, assistant engineer of motive power and master mechanic until the summer of 1917. He then received a commission as major in the United States Army and went to France in command of the First Battalion of the Nineteenth Engineers. In France Major Barrett organized the St. Nazaire locomotive erecting shop, where all the locomotives used by the A. E. F. were erected. He remained in charge of this shop until July, 1918, when he was appointed assistant general superintendent of motive power in the Transportation Department.

C. D. Barrett

Oscar F. Ostby & Co., Inc., is the name of a new corporation recently organized, with Oscar F. Ostby as president. Mr. Ostby's offices, at 1044 Grand Central Terminal, New York, are the headquarters of the company, which will continue to handle the lines of railway supplies hitherto handled by Mr. Ostby, and in addition is the exclusive railway distributor for Davidson high speed steel and tools, manufactured by the Davidson Tool Manufacturing Corporation, New York. Mr. Ostby was born on March 5, 1883, and received his education in the public schools of Providence, R. I. From 1901 to November, 1904, he was engaged in publicity work, following which he was connected with the Commercial Acetylene Railway Light & Signal Company, serving as president of the International Acetylene Association during 1910-11. Later he was general manager of the Refrigerator, Heater & Ventilator Car Company. He has for some time represented the White American Locomotive Sander Company of Roanoke, Va., and since September, 1918, has served as vice-president of the

O. F. Ostby

Glazier Manufacturing Company of Rochester, N. Y. Mr. Ostby has been one of the leading members of the Railway Supply Manufacturers' Association and was its president in 1915-1916.

Stone Franklin Company

The Stone Franklin Company has been organized to market the Stone Franklin car lighting system in the United States and Canada. This system was introduced into this country by the Franklin Railway Supply Company. The new company has elected the following officers: Joel S. Coffin, chairman of the board of directors; Ralph G. Coburn, president; C. E. Walker, vice-president; H. D. Rohman, chief engineer, and W. Truelove, secretary, with offices at 18 East Forty-first street, New York.

Ralph G. Coburn, president of the new company, has been identified with the Franklin Railway Supply Company. He was born at Boston in 1882, and graduated from Harvard in 1904. From 1904 to 1909 he was in the service of the American Glue Company, having charge of its western factories with his headquarters at Des Moines, Ia., and Chicago. On May 1, 1909, he opened the Chicago office of the Franklin Railway Supply Company as resident sales manager. On June 1, 1911, he was made assistant to the vice-president, in charge of eastern-southern territory, with headquarters at New York. In December, 1913, he was appointed eastern sales manager of the Franklin Railway Supply Company, which position he held until his appointment with the Stone Franklin Company.

R. G. Coburn

Charles E. Walker, vice-president of the new company, has had a broad experience in industrial manufacturing, sales and railroad work both in this country and abroad. He is a graduate of the engineering course of the University College, of Bristol, England. He served as an apprentice with the Bristol Railway Carriage Company and as junior assistant on the staff of the Newcastle Electric Supply Company. He later went to South America on the mechanical constructional staff of the Buenos Ayres & Pacific Railroad. While in South America he joined J. Stone & Co., Ltd., as technical adviser and sales manager with office in Buenos Ayres. In the latter part of 1912 he went to England to take charge of foreign sales in the main office at London. When war was declared he joined the British army and saw active service at the front for nearly three years. Receiving the order of the British Empire in February, 1917, he was returned to England to take charge of the manufacture of anti-submarine devices, which is the work he leaves to take up the position of vice-president of the Stone Franklin Company.

C. E. Walker

Harry D. Rohman, chief engineer of the Stone Franklin Company, New York, is a graduate of the technical schools of Zurich, Switzerland. Upon graduation he entered the works of the Oerlikon Electrical Construction Company, and in 1903 qualified as an electrical engineer, with experience in high and low tension and a. c. and d. c. work, especially electrical traction. Later he entered the service of J. Stone & Co., London, and in 1910 was appointed chief of the testing and experimental departments. In 1914 he was appointed chief assistant electrical engineer, and held that position until October 1, 1915, when he entered the service of the Franklin Railway Supply Company as chief electrical engineer, which position he held at the time of his recent appointment. Mr. Rohman speaks several languages and has had an extensive experience in all European countries, as well as in South Africa and the Belgian Congo. He has a broad experience in car lighting engineering, obtained by many years of active work in that field.

H. D. Rohman

E. Roy Bordon has been appointed service engineer of Mudge & Co., in which capacity he will have charge of investigating service given by the products manufactured by that firm and their successful handling, care and operation. He was born on January 17, 1893, at Galveston, Tex., and after graduation from the public schools entered Purdue University, Lafayette, Ind., where he remained for three years, at the end of which time he entered the service of the Pennsylvania at Fort Wayne, Ind., as a special apprentice in the shops of that road. The following year he returned to Purdue University, graduating from that institution as a mechanical engineer in June, 1915. In the fall of the same year he entered the employ of the Atchison, Topeka & Santa Fe in the test department where he remained until December, 1917, at which time he was commissioned a second lieutenant in the ordnance department of the United States army and sent to France. On February 13, 1919, he received his honorable release from the service and returned to the testing department of the Atchison, Topeka & Santa Fe, which position he held prior to his appointment with Mudge & Co. on May 1.

E. R. Borden

William K. Stamets, Pittsburgh, Pa., announces the opening of an office in Cleveland, Ohio, under management of William S. Dickson, formerly general manager of the Greaves Klusman Tool Company, Cincinnati, Ohio. The Stamets organization will represent exclusively most of machine tool manufacturers it now represents in Pittsburgh.

The Toledo Pipe Threading Machine Company, Toledo, Ohio, has organized a "Toledo Ten-Year Club," whose membership will be limited to owners of Toledo pipe threader machines that have been in service ten years. All applications for membership must be in by July 1, 1919, and on that date the six members owning the six oldest "Toledos" will be notified and given their choice of a Toledo ratchet threader complete or a Toledo, No. O, tool.

Colonel Douglas I. McKay has been elected president of the Pulverized Fuel Equipment Corporation, New York, to succeed John E. Muhlfeld, who has retired to return to consulting engineering practice. Since July, 1917, Colonel McKay has been engaged in war work. He was commissioned major in the Ordnance Department in charge of the raw materials branch of the gun division and purchased all raw and semi-finished materials used by the ordnance department and contractors for the ordnance department. Between August and December, 1917, these purchases amounted to $268,000,000. In January, 1918, he was promoted to lieutenant-colonel in the National Army and appointed assistant director of purchase and supply. Here he had supervision over the purchasing operations of the several supply corps of the War Department, including the ordnance department, the quartermaster department, the medical corps, the corps of engineers and the signal corps. He was subsequently promoted to colonel, and continued in this capacity until he returned to civil life after the armistice was signed. In addition to his duties as president of the Pulverized Fuel Equipment Corporation, Colonel McKay is also vice-president and director of the Chemical Foundation, Inc., director of the International Agriculture Corporation and director of the Botany Worsted Mills.

Col. D. I. McKay

Willis B. Clemmitt and George H. Ruppert have entered the employ of the Powdered Coal Engineering & Equipment Company of Chicago as advisory engineers. Mr. Clemmitt was formerly associated with the Central Iron & Steel Company at Harrisburg, Pa., and Mr. Ruppert, before his entry into the chemical branch of the government military service, had charge of the sodium-ferro-cyanide department of the Semet-Solvay Company.

The Wetmore Reamer Company is the new name of the Wetmore Mechanical Laboratory Company, of Milwaukee, Wis. This company has completed all of its contracts with various munition makers of Canada and this country to whom it supplied Wetmore expanding reamers, hobs, taps, lathe and boring bar tools. Since the completion of this work it has resumed its former tool business, specializing in a type of expanding reamer for all grades of industrial reaming operations. More floor space has been added and the offices enlarged. P. H. Door, recently released from the government service, is secretary and sales manager.

The Carborundum Company

Frank J. Tone has been elected president of the Carborundum Company, Niagara Falls, N. Y., in place of F. W. Haskell, deceased, and George W. Rayner has been elected vice-president. Mr. Tone was formerly works manager, having been in charge of manufacturing operations since the setablishment of the works at Niagara Falls in 1895. He was previously engaged in electric railway work in Pittsburgh. He is well known for his work in the electric furnace field on artificial abrasives, refractories and silicon alloys, and is past president of the American Electrochemical Society. Mr. Tone graduated from Cornell University in 1891.

F. J. Tone

George R. Rayner, the new vice-president of the Carborundum Company, was born in Springfield, Mass. He served for a period of time as a member of the sales force of the Hampden Wheel Company, and in June, 1898, he was appointed manager of the Chicago branch of the Carborundum Company. In August of the same year he was transferred to Niagara Falls, and was appointed secretary and general sales manager of the company. Mr. Rayner is a past president of the American Foundry & Supply Association and is a member of the board of directors of the Chamber of Commerce, at Niagara Falls.

G. R. Rayner

Railway Business Association

This association's committee on government purchasing policies was organized in New York City recently. The chairman of the committee is Knox Taylor, president of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J.; and the other members are Samuel G. Allen, vice-chairman, Franklin Railway Supply Company, New York; G. S. Brown, president, Alpha Portland Cement Company, Easton, Pa.; Andrew Fletcher, president, American Locomotive Company, New York; Howard A. Gray, manager railroad sales, Joseph T. Ryerson & Son, Chicago; A. L. Humphrey, president, Union Switch & Signal Company, Swissvale, Pa.; A. H. Mulliken, president, Pettibone, Mulliken & Co., Chicago; L. G. Parker, assistant manager of sales, Cleveland Frog & Crossing Company, Cleveland, Ohio; W. H. Woodin, president, American Car & Foundry Company, New York.

Colorado Brake Shoe and Foundry Company

The Colorado Brake Shoe & Foundry Company, Denver, Colo., was organized on January 1, 1919, by James C. Dolan, representative of a number of railway and mine equipment and supply firms at Denver, Colo. Mr. Dolan, in addition to assuming the presidency of the new company, retains his connection with the companies with whom he has been engaged for the past six years. Previous to this he was in the employ of the purchasing department of the Denver & Rio Grande for nine years.


J. C. Dolan

F. T. Dickinson, general manager of the new company was formerly superintendent of the Railway Material Company's plant at Toledo, Ohio, and later the plants at Phoenixville, Pa., and Stevens Point, Wis. Mr. Dickinson has been associated with the foundry business for the past 35 years, having received his early training in the general foundry business in Chicago. He first became interested in the manufacture of reinforced brake shoes while working for the Union Iron & Steel Company of Chicago in 1905. Soon after Mr. Dickinson was employed by the American Brake Shoe & Foundry Company, and here he was given opportunity to develop ideas on permanent iron molds for making brake shoes. After remaining with the American Brake Shoe & Foundry Company for two years he resigned to establish the Illinois Malleable Company, of Chicago, in the brake shoe business. In 1909 Mr. Dickinson resigned from this company to accept the superintendency of the Railway Material Company's plant at Toledo and later, while still in the employ of this company, started and operated its new plant at Phoenixville, and later at Stevens Point, retaining the latter position until his appointment as general manager of the Colorado Brake Shoe & Foundry Company. Mr. Dickinson is the inventor of numerous brake shoes and foundry devices pertaining to the manufacture of steel brake shoes.


F. T. Dickinson

The company has acquired a modern brake shoe foundry with a floor space of 150 ft. by 250 ft. and equipped with modern machinery. This foundry has a capacity of 50 tons a day, entirely of reinforced brake shoes.

As a war memorial to the more than 8,000 employees of the Westinghouse Electric & Manufacturing Company who have entered the service of the government in the war, the company has decided to establish four technical scholarships each year. Candidates will be limited to sons of employees of the Westinghouse Electric & Mfg. Company and its subsidiaries and to the younger employees of the company or its subsidiaries who have been in their service for a period of at least two years and who do not exceed the age of 23. The selection is to be determined by competitive examination, to be conducted annually by the company's educational department under direction of a committee composed of three vice-presidents of the company.

Vauclain Succeeds Johnson as Head of Baldwin Locomotive Works

Alba B. Johnson, president of the Baldwin Locomotive Works, has resigned from that position and has been succeeded by Samuel M. Vauclain, hitherto senior vice-president. Mr. Johnson, who had been contemplating the step for a considerable time, presented his resignation at a special meeting of the board of directors in Philadelphia, May 9. He will retain his extensive interests in the company and will remain a director. In connection with the resignation and the election of Mr. Vauclain as president, there were rumors of friction between different interests in the company, but the existence of such friction has been emphatically denied by Mr. Johnson and Mr. Vauclain alike.


A. B. Johnson

Following the meeting of the board of directors, Mr. Johnson issued a statement in which he explained that he had desired to withdraw from the presidency of the company in order to devote his time to his extensive personal and public interests and in which he expressed his wishes for the success of Mr. Vauclain.

Mr. Vauclain declined to issue any statement, but said in answer to a question that there would be no change in the policy of the company.


S. M. Vauclain

Mr. Johnson has been connected with the Baldwin Locomotive Works since 1877 and its president since 1911. He was born at Pittsburgh, Pa., February 8, 1858, and upon his graduation from the Central High School of Philadelphia entered the employ of Burnham, Parry, Williams & Co., as the present Baldwin Locomotive Works was then known, as a junior clerk in May, 1877. On the advice of John H. Converse he studied stenography and then for about 20 months was in the employ of William Sellers of the Edge-Moor Iron Works, Wilmington, Del. Upon returning to the Baldwin works

he became secretary to Mr. Converse and served in that capacity for 33 years, gradually working up in the company and taking over Mr. Converse's work. In 1896 he was made a partner in the firm of Burnham, Williams & Co., as the firm had then become known, and was in charge, first of sales and later, on the withdrawal of George Burnham, Jr., of sales and finances. Upon the incorporation of the company under the name of the Baldwin Locomotive Works on July 1, 1909, he was elected vice-president and treasurer, becoming president on July 1, 1911.

In the period during which Mr. Johnson was president the company had what may truly be called a phenomenal growth, its gross sales having increased from a total of $29,000,000 in 1912, the first full year after he became the head of the company, to over $98,000,000 in the year ended December, 1918. The total undivided profits over the same period increased from $4,470,000 in 1912 to $5,752,000 in 1918, while in 1917 a total was reached of $8,306,000, excluding the return from the Standard Steel Works Company and the Southwark Foundry & Machine Company.

Mr. Johnson has extensive personal and public interests, and is one of the country's leaders in export trade. He is president of the Railway Business Association; a member of the National Foreign Trade Council, having acted as president of all the National Foreign Trade conventions with the exception of the one in Cincinnati last year, and is connected with other commercial and civic organizations.

Samuel M. Vauclain, the new president of the Baldwin Locomotive Works, has been connected with the company or its predecessors since 1883, and its senior vice-president since 1911. He entered the employ of the plant in 1883 as a foreman. In November, 1885, he was promoted to superintendent of equipment, and in 1886 was advanced to general superintendent. He became a member of the firm of Burnham, Williams & Co., in 1896, and in 1911 was elected a vice-president of the Baldwin Locomotive Works. It is through his work as manager of operations in the Baldwin Works that Mr. Vauclain is generally recognized as one of the leaders in shop management in the country.

Mr. Vauclain's greatest work, however, was during the war, not only in connection with the work of the Baldwin Locomotive Works in supplying locomotives for the allied armies overseas, but also in connection with the great shell making plant of the Eddystone Munitions Company at Eddystone, Pa. Mr. Vauclain was on a number of occasions called into consultation with various of the allied governments, and so well was his work regarded that he was made a chevalier of the Legion of Honor by the French government. At a banquet given in his honor at the Bellevue-Stratford Hotel in Philadelphia on May 17, he was presented by Benedict Crowell, assistant secretary of war, with the Distinguished Service Medal for the part he played in America's mobilization for war. In this connection he served with the Council of National Defense, first in an advisory capacity and later as chairman of the committee on ordnance and as chairman of the committee on cars. After the War Industries Board was organized he became chairman of that body's special committee on plants and munitions and was also the head of the committee of car and locomotive builders.

Carl H. Peterson, western representative of the Baldwin Locomotive Works, Philadelphia, Pa., and the Standard Steel Works Company, Philadelphia, with headquarters at Chicago, resigned on May 1, to become president of the Iron Mountain Company, Chicago, and vice-president of the Jackson-Park Machine Company, Chicago. Mr. Peterson will be succeeded by Arthur S. Globe, southwestern representative of the Baldwin Locomotive Works and the Standard Steel Works Company, with headquarters at St. Louis, who will have the title of manager of the Chicago office, the title of representative having been abolished. Paul G. Cheatham, assistant to the western representative, with headquarters at Chicago, will become manager of the St. Louis office.

General Miller Heads New Oil Company

General Charles Miller, of Franklin, Pa., has assumed the chairmanship of the board of directors of the Home Oil Refining Company of Texas. General Miller occupies a unique position in the history of American railroads. He was the first man to recognize the great importance of a scientific study of oil and lubrication problems in transportation, and he taught the railroads the best ways and means to efficient and economical use of lubricating oils. Prior to 1869 the railroads began using what was known as pure West Virginia oil (a mineral oil from 28 to 29 gravity with a cold test of 10 below zero and a fire test of 175).

General Charles Miller

In July, 1869, General Miller formed a partnership with three associates and began to manufacture an oil in all appearances like pure West Virginia oil and meeting the same tests. The product was, however, superior because of the addition of certain materials. The company made a specialty of supplying railways with cylinder, engine and freight car oils. General Miller studied the subject of railway lubrication in all its aspects. His company was the first to formulate a plan of furnishing railway oils under contracts guaranteeing the cost per thousand miles on locomotives and freight cars. It was the first to organize a department of lubrication experts, whose services were given to the railroads.

In 1878 the Galena Signal Oil Company was shipping 12,000 barrels per year, supplying about 15 per cent of the railroad mileage in the country. In 1918 its product was said to be standard upon approximately 98 per cent of the entire railway mileage of the United States and Canada, with a large export trade to France and South America. With the advent of electric railways the company developed special oils to meet their requirements, making contracts on the same basis which had proved so satisfactory to the steam railroads. Not only did the company furnish lubricants to the railways but also signal oil, long time burner oil, headlight oil and other illuminating oils.

General Miller severed his connection with the Galena Signal Oil Company some months ago because of differences of opinion as to policy. The Home Oil Refining Company which he heads as chairman of the board has large oil contracts covering a production of 7,500 barrels per day in the Ranger and Burkburnett (Texas) fields. It also holds leases on approximately 200,000 acres of oil lands exceptionally well located and now in process of development. The company owns a refinery at Yale, Okla., now operating at 2,500 barrels daily capacity. It is constructing a large refinery at Fort Worth which will be in operation in a few weeks. Nearly 600 men are now engaged in the construction work on the site of 165 acres located on the St. Louis-San Francisco Railway in the outskirts of Fort Worth. Recently the Home Oil Refining Company purchased a convenient site of 50 acres at Franklin, Pa., for the erection of a large plant for the production of railroad oil.